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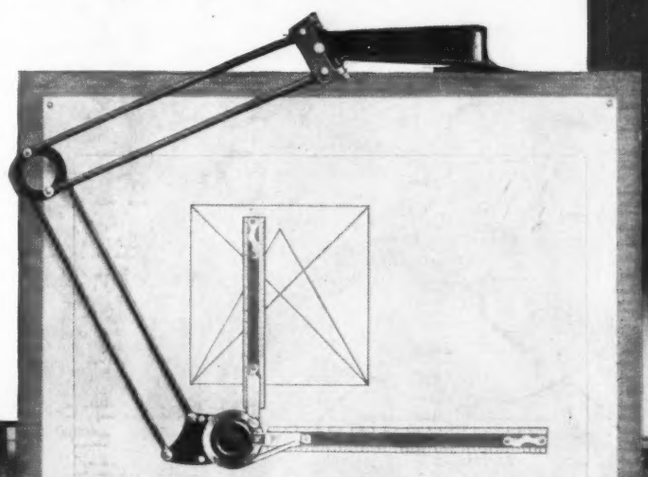

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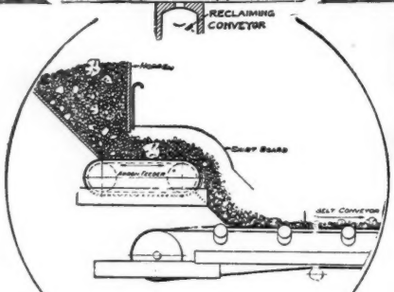

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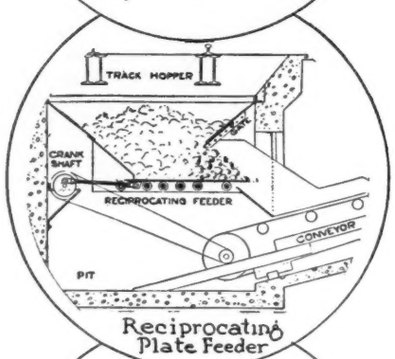

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Mining Journal

VOLUME 101 APRIL 22, 1916 NUMBER 17

The Milling of Tungsten Ores

By James F. Magee*

SYNOPSIS—The extraordinary importance of tungsten at present draws attention to the methods for its recovery, until lately a factor of little interest in this country. The methods of milling and concentrating tungsten ores are described in detail.

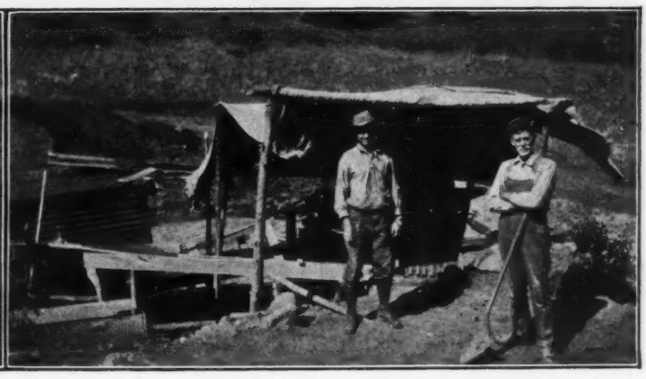
The remarkable rise in the price of tungsten in this country since the beginning of the war has stimulated the mining of tungsten ores in Boulder County, Colo., to a remarkable degree. Ores, however, are never in large deposits, and in this district the majority of producers are small leasing miners who work on a small scale and sell their ore to the concentrating mills on a schedule of prices graded according to the percentage of tungstic oxide in the ore. The scarcity of ore in place and the relatively high price paid for high-grade ore have led to considerable work in the reclamation of dumps, stope dirt and float patches, which in some cases are well organized and are handling low-grade material profitably.

The tungsten mineral most abundant is ferberite, the tungstate of iron, usually containing a small amount of tungstate of manganese. This mineral has a specific gravity of 7.5 and is associated with a tough horn-quartz in veins in granite. It is rather hard to crush usually. For small-scale operations it seems to be most easily concentrated by jigging after some sort of rough sizing. Probably the majority of jigs used are hand-operated and of the plunger type. Where water is scarce, the Joplin type of movable screen-box hand-jig is used, but where plenty of water is available and an amount of material to justify the installation is present, power jigs are preferable.

In hand-jigging it is customary to treat material that will pass a ¾-in. screen on the jig. In screening, the pieces of ore in the oversize are picked out by hand. The screen area varies from 2 to 4 sq.ft. or more. The piston stroke varies from ½ in. to 3 in. and probably averages 40 strokes to the minute. The water consumption appears to average the capacity of flow through a 1-in. pipe without head. A bed of from 2 to 3 in. is carried on the screen, and the concentrates that accumulate on the screen are cleaned up to make two classes—the high-grade, assaying from 50 to 63% tungstic oxide, and the second grade, assaying from 25 to 40%. The hutch product is very little enriched in the jigging. It is seldom worked up by the operator, being rejected or sold to the mill if it assays as much as 3% tungstic oxide. Occasionally it is worked through a rocker or buddle and part of the value saved.

As the operators who concentrate by hand-jigging keep no very close account of capacity, cost or assay values, a detailed statement of their operations cannot be given.

TAKING FLOAT GRAVEL FROM A PIT



OPERATING A POWER JIG ON THE TREVARTEN RANCH

The capacity of the jigs varies from 1 to 5 tons per day, and it may be estimated roughly that they screen and jig the material at a cost of from $2 to $5 per ton. No data are available for a computation of saving.

Two installations of jigs that were observed, however, supply some basis for computation of cost and saving that is fairly accurate. One of these is operated by Otto and Dale Hinman on the dump of the Cold Spring No. 1 mine of the Wolf Tongue Mining Co. The dump dirt is wheeled to a platform over a stationary screen of 1¼-in. opening, the oversize falls to a sorting bench where it is hand-picked and cobbed, the undersize goes to a double shaking screen where three sizes are made. The first size, from 1¼-in. to ½-in., is crushed through a set of rolls; the second and third sizes, from ½-in. to ¼-in. and ¼-in. to 0 respectively, are jigged separately.

A 5-hp. motor runs the jig and shaking screen. The former is a two-compartment plunger-type machine, hav-

*Sugar Loaf, Colo.

ing a stroke of 1½ in. and a speed of 200 r.p.m. with a screen area of 18x30 in. for each compartment. The dirt is fed through a launder with a part of the water and enters the head end of the first compartment directly. The water consumption is 150 gal. per min. and is fed into the plunger compartments, except for the small amount that enters with the heads. The bed is carried 4 in. deep on a 12-mesh screen supported on a heavier screen. Formerly pockets for the automatic discharge of the concentrates were used, but now the concentrates are allowed to accumulate until the screen box is filled, when the feed is cut off, all the waste is scraped off and the concentrates are sacked directly from the screen. No bed is left after this cleanup. The high-grade concentrates are all obtained in the first compartment, the middlings, or second grade, in the second compartment. It is claimed that a higher grade of concentrates can be made in this way than by automatic discharge through pockets from the bed.

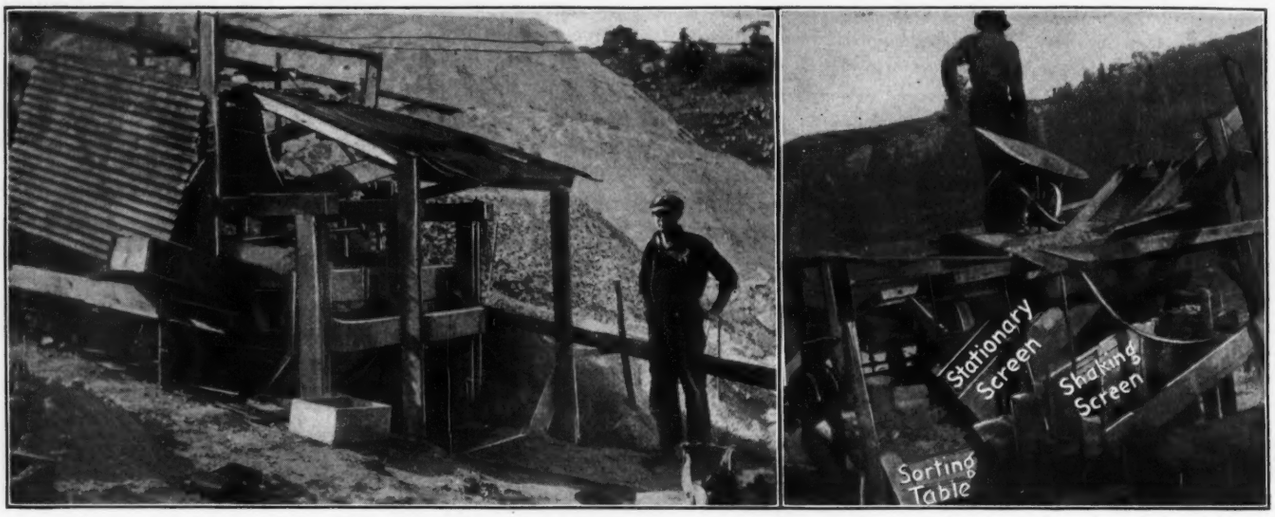
The hutch product is continuously discharged to a launder 18 in. wide with 1-in. transverse riffles placed at intervals of 24 in. on the bottom. The slope is approximately 1 in 20. This launder is 30 ft. long and apparently catches most of the tungsten contained in the hutch product.

The capacity of the plant is 6 tons per day. The high-grade concentrates assay 50 to 55% tungstic oxide, and the second grade 30%. The cobbed ore assays 35% to 40% tungstic oxide. The hutch product assays 3% tungstic oxide before going over the riffles. After being cleaned in the riffles, it is approximately the grade of the second-class concentrates.

The force employed is 2 men wheeling, 1 man sorting and 1 jigman. The installation cost approximately $150. Operating costs are, for power, $0.12, and for labor, $2 per ton. The dirt that is being worked varies from 1% to 4% of tungstic acid.

Another installation is that of Chester Gillette and Ben Flarty on a float patch on the Trevarten Ranch. The float lies in channels in the bedrock in gravel varying from a few inches to 4 ft. in thickness. Over the gravel bed is clay and loam up to 6 ft. in depth. The clay and loam are removed with a scraper, the gravel is loaded on a wagon and hauled from the pit to the jig. The gravel is screened over a 1½-in. grizzly, the oversize being sorted by hand and the undersize falling directly into the feed launder. The water, 100 gal. per min. is all fed into the jig through the feed launder.

The jig is a two-compartment plunger-type machine having a screen area of 19x30 in. for each compartment. The plunger stroke is 1¼ in. running at a speed of 112 r.p.m. The method of cleaning up the concentrates is the same as in the installation formerly described, except that no middlings are obtained from this class of material, and after cleaning up the first compartment, the heavy material from the second compartment is thrown back into the first to form a bed. The hutch product is allowed to waste. It contains 1½% of tungstic oxide, but has so much intimately associated magnetic oxide of iron with it that good concentrates cannot be made from it, even in a well-equipped mill.



POWER JIGS ON THE COLD SPRING DUMP AND SCREENS AND SORTING TABLES ON THE SAME DUMP, OPERATED BY HINMAN BROTHERS

The force consists of a team and teamster, two men in the pit and one man feeding the jig. The capacity is 10 tons of material per day. The gravel varies from ¾% to 1½% of tungstic oxide. Operating costs are, for power, $0.07, and for labor, $1.40 per ton treated.

The Wedge Furnace for Blende Roasting

One of the recent interesting developments in metallurgical engineering is the extensive and successful use of the Wedge furnace for blende roasting. At present there are 27 Wedge roasters either in operation or in course of installation for this purpose. The Wedge furnace engineers devoted several years' work and a good deal of money to the development of a blende roaster, with the object of securing a good calcine, a rich gas (where it is desired to produce acid) and economy in fuel.

It was their experience that under proper furnace conditions a very large percentage of blendes were self-roasting down to 3% to 5% sulphur without the use of any fuel. To eliminate the remaining 3% to 5% sulphur, it seemed desirable to avoid muffle-firing as far as possible; in other words, not to spend more money

for fuel than a few points of sulphur were worth. In the recent designs of this furnace the production of zinc ferrite and zinc sulphate are both avoided. In roasting a zinkiferous pyrite, it has been possible to secure a calcine with practically no sulphur present as ZnS, with only a trace of $ZnSO_4$ and with less than ½% iron as FeO. This produces a calcine desirable for leaching.

The "Bear Squeeze" in Copper

On the London Metal Exchange Mar. 22, says the London *Financial Times,* standard copper jumped a further £6 to the new high record for modern times of £118 buyers per ton. Bitter comments were heard on 'Change as to the artificial position which this movement reflects, and which is apparently the direct outcome of the ill-digested government regulations forbidding speculation in war metals, which were so autocratically promulgated without any warning on the evening of the 1st instant, when copper stood at only £101 per ton. We remarked at the time that while in metal-market circles general approval was expressed of the principle of prohibiting illegitimate speculation in war commodities, there were grave doubts in many minds as to whether the step taken by the authorities was necessary or desirable, whether it had been well considered and whether it was likely to achieve its presumable object.

The Effect on Copper and Lead

It will be remembered that within a few days amendments to the original regulations were issued, and while the concessions thus made by the Ministry of Munitions did not fully meet all the trade criticisms, the members of the Metal Exchange have loyally attempted to make the best of them. But a dangerous position has now been created, at any rate temporarily, by the "bear squeeze" in standard copper, and to a lesser extent in lead, which has grown out of the provision that, while on the one hand all speculative contracts must be closed as they fall due or at latest by May 31 next, on the other hand what amounts to a protection of bulls in the trade (as distinct from "outside" speculators) was afforded by clause No. 3 of the amendments issued on the 5th instant:

> It is permissible for merchants, warehousemen and retailers to replace metals sold after Mar. 1, 1916, by the purchase of an equivalent quantity of the same metal, but not more, although the metal so purchased may not be the metal actually delivered against the sale.

We pointed out at the time what an advantage this clause gave to merchants who happened to have been in the position of holding large stocks on Mar. 1 over those who for patriotic or other reasons had kept their books even, or nearly so.

The bears—who, we believe, are not unduly numerous and happily are probably mostly sufficiently wealthy to stand heavy losses with more or less philosophy—now find that the advantage which trade bulls hold over them at present under the Government Regulations is overwhelming. Whereas the unfortunate bear must buy back the metal he has sold forward as the warrants fall due, if not before, the trade bull (although he may not be an actual consumer) can go into the market and compete against his rival for the scanty supplies available, so long as on balance he does not raise his stock of the metal above what he was "long" of on Mar. 1. The result is that while the buyers are, practically speaking, as numerous as ever, the sellers have been reduced in number to the extent of the bears, most of whom were quite prepared to continue their "short" commitments indefinitely on the conviction that a break in prices must occur eventually. As it is, unless the members of the Metal Exchange themselves put their heads together, or unless the committee takes some steps in the matter, the price of standard copper may be forced up against the bears before the end of May to a level that may cause serious embarrassment to consumers.

So far the price of copper in the United States has remained almost stationary since the introduction of the Government Regulations here, but it must amuse the Yankee bulls to see that the British authorities have practically played the former's game for them. It did not follow—rather the contrary—because the limitation of Stock Exchange speculation since the war had successfully prevented any possible panic, that the tying-up of the hitherto free market in metals in bonds of red tape would prevent the boom going further. Dissimilar evils require dissimilar remedies. As it is, the government "cure" has so far proved, if anything, worse than the disease for which presumably the authorities thought it would prove a specific.

Lena Goldfields Will Dredge Siberian Gravels

At the recent meeting of the Lena Goldfields, Ltd., in London, the chairman, Lord Harris, announced that arrangements had been made that would put the company in the position of having a liquid capital of £1,000,000—though there was objection to the sale of 10,000 Lenskoie shares for £300,000. It was essential, the chairman said, to place the company in a strong position financially, if it were to profit by the recommendation of its consulting engineer, C. W. Purington, who had suggested that some of the gravels near Bodaibo, Siberia, should be dredged, the life of the properties as a drift-mining operation being limited. A committee of experts, which visited the mines last year, confirmed his views that there were great possibilities for dredging at the Lena properties. Continuing, Lord Harris said:

> Dredging has been carried on in other parts of Russia, but not as yet on the Lena properties. If dredging is to be resorted to as well as drift mining—and it is unquestionably a more economical method of producing gold than drift mining—a large outlay of capital will be required. The gold-bearing strata lie at a considerable depth; a great deal of old timber and some large boulders will have to be moved, and in consequence it is at present considered necessary to use a very powerful dredge. I may say that the tendency of dredge mining in the world is in the direction of much larger dredges than has hitherto been common, and we have, of course, to deal with climatic conditions that are not customary.
>
> We have, however, a practical example of what has been done in the Klondike, and proceeding on the same lines as have been adopted there, it means in the first instance a large dredge, which will have to be conveyed immense distances by sea and land under the exceptional conditions that at present prevail. The cost of the dredge and of carriage involve a large expenditure, but this company will be, in consequence of the provision we have made as regards liquid resources, in a specially fine position to assist Lenskoie if that company needs our help. The property is so large and, so far as we have gone, the results of drilling are so encouraging that we cannot ignore the possibility of following up the first dredge with others of equal capacity and possibly with others of smaller capacity on separate areas. It is obvious, therefore, that considerable cash resources are likely to be wanted in the approaching year. . . .

In what I have said as regards the new departure of dredging parts of the Lenskoie property, I should not wish to be misunderstood. We are proceeding with caution and with due regard to the exceptional conditions as regards transport that prevail at present. It may not be possible to take the necessary steps to set the new industry on foot as early as if these conditions did not prevail, but there is an absolute unanimity between the boards of the two companies that when the contingent circumstances permit no time should be lost in making the first experiment in this direction.

Objection was entered to the sale of the 10,000 Lenskoie shares at £30 on the ground that it was not a sufficient price. Before the war Lenskoie shares were quoted in Petrograd as high as 800 to 850 rubles, equivalent at normal exchange to about £82 to £87. In January, 1916, the price of the shares averaged 530 rubles, or about £55 a share at normal exchange, but at this time £10 would buy 160 rubles instead of the normal 95 rubles.

Considering conditions, Lord Harris said he regarded the firm sale of the 10,000 shares for £300,000 as satisfactory, notwithstanding they had subsequently received an offer £1 higher per share. Lenskoie, now dependent on drift-mining profits, had a life with this form of mining of less than five years, according to Mr. Purington, and the profits would be about £800,000. Hence the necessity of getting the proposed dredging operations under way and of making provision for the capital required.

The Recovery of Gallium from Spelter*

Some months ago a few grams of gallium of American production were received by one of us (S) from F. G. McCutcheon, chemist of the Bartlesville Zinc Co., Bartlesville, Okla. Recently the other (H) received 50 grams more from Mr. McCutcheon.

The first material contained a little indium and zinc and a trace of calcium, as determined spectroscopically by Dr. K. Burns at the Bureau of Standards. The second lot is of similar composition, presumably. An as yet uncompleted test by one of us (H) indicates an indium content probably of less than 1 per cent.

The metal, or alloy, is a liquid resembling mercury in appearance, but it wets glass and porcelain and adheres so tenaciously that if agitated in a glass vial the contents can be seen only as a coating on the walls. This latter property is not in evidence if the metal is covered with hydrochloric or sulphuric acid.

Although gallium melts at about 30°, it is said to remain liquid far below this temperature indefinitely unless inoculated with solid gallium.

Inquiry of Kurt Stock, superintendent of the Bartlesville Zinc Co., brought out some exceedingly interesting information, as shown by the following extracts from his letter of reply, dated Oct. 21, 1915:

His attention [Mr. McCutcheon's] was drawn to peculiar heads and drops, in appearance like mercury, which seemed to sweat out of zinc-lead dross plates after these had been exposed to the weather for a time. Mr. McCutcheon, with the help of his two assistants, made a great number of tests, proving the material to be an alloy of gallium and indium with small amounts of zinc. . . .

Your hope that a new source of supply for both metals has been opened up, with the prospect of continued manufacture, is not shared by me, as the conditions leading to the concentration of gallium and indium are very unusual and are based on the abnormal state of the spelter market. You are aware that the present demand for high-grade spelter has led zinc smelters to the practice of redistillation, and it is the final leady residue from such continued redistillation that carries gallium in noticeable quantities. . . . We are not at all sure which of the large variety of ores is responsible. Gallium is not found in all dross, and where it is found it does not occur continuously. . . .

That the amount in the original ores must be extremely small can well be realized when you consider that the residue from the continued distillation of about 12,000 lb. of spelter weighs about 60 lb. and represents our raw material from which we can obtain a few grams of the alloys. However, we have at present about 45 tons of dross on hand, which we suspect carries gallium.

A very interesting feature is that both gallium and indium are volatile at the temperature prevailing in our ore furnaces, where a maximum of 1,350° C. is reached for only a few hours, but they resist distillation if kept for three weeks and longer at the temperature at which we operate our redistilling furnaces—about 1,000° C.

Please be assured that we shall leave nothing untried to save these rare metals, but do not get impatient if results are not forthcoming for a while. . . .

Since the foregoing was written, spectroscopic tests have been made at the Bureau of Standards by Dr. K. Burns upon seven samples of zinc ore kindly supplied by S. M. Rodgers, of the American Steel and Wire Co. Germanium was also included in the metals looked for. The data concerning the precise sources of some of the ores tested are unfortunately meager, particularly with respect to Nos. 2, 4 and 7, but the presumption is strong that No. 4 came from the Joplin District. Of special interest is the fact that this ore showed more of both gallium and germanium than any of the others. The tests obtained by Doctor Burns follow:

SPECTROSCOPIC TESTS OF ZINC ORES

No.	Kind and Source of Zinc Ores	Germanium	Gallium
1	Sulphide—Sunset, Idaho	Moderate	Moderate
2	Sulphide—Australia	Not found	Moderate
3	Sulphide—Frisco, Idaho	Weak	Moderate
4	Sulphide—Missouri	Strong	Strong
5	Carbonate—Monarch, Leadville	Absent	Moderate
6	Carbonate—Doctor Mine, Almont, Colo.	Moderate	Not found
7	Carbonate—Utah, Nevada	Very weak	Rather weak

*Excerpt from article by W. F. Hillebrand and J. A. Scherrer in the "Journal of Industrial and Engineering Chemistry," March, 1916.

Radium Never Seen in Nature

Radium is a metal and is described as having a white metallic luster. According to a United States Geological Survey bulletin, it has been isolated only once or twice, and few people have seen it. It is ordinarily obtained from its ores in the form of hydrous sulphate, chloride or bromide, and it is in the form of these salts that it is usually sold and used. These are all white or nearly white substances, whose appearance is no more remarkable than common salt or baking powder.

Radium is found in nature in such exceedingly small quantities that it is never visible even when the material is examined with a microscope. Ordinarily radium ore carries only a small fraction of a grain per ton of material, and radium will never be found in large quantity because it is formed by the decay of uranium, a process which is wonderfully slow, and radium itself decays and changes to other elements so rapidly that it is impossible for it to accumulate naturally in visible masses.

Minerals that carry radium, however, are fairly easy to determine. One of them, pitchblende, as generally found, is a black mineral about as heavy as ordinary iron, but much softer. The principal radium mineral, carnotite, has a bright canary-yellow color, and is generally powdery. There are other radium-bearing minerals of less importance.

Petroleum Production in India is becoming important, according to "Engineering." The production rose from 144,798,444 gal. in 1905 to 214,829,647 gal. in 1910, 277,555,225 gal. in 1913 and 259,342,710 gal. in 1914. Of this Burma produced 142,063,846 gal. in 1905 and 254,652,963 gal. in 1914.

Seasoning Reverberatory Furnaces

By E. C. King*

The enormous expansion and disastrous results of sudden temperatures upon silica brick are so great that they can be fully appreciated only by intimate association with such work. It is therefore not surprising that serious and costly experiments have resulted during the rapid development of reverberatory furnaces, and that means were sought to obviate the difficulties. Auxiliary fireboxes burning wood, coal and oil and other means have been tried, but without complete success.

A study of the most practical means to season the new 100-ft. reverberatory furnace of the Consolidated Arizona Smelting Co., at Humboldt, Ariz., developed the installation shown by the accompanying drawing. This consists of a 36-in. Buffalo Forge Co. suction fan, running at a speed of 1,000 r.p.m. It is driven by a G. E. 5-hp. 440-volt induction motor running at a speed of 1,735 r.p.m. The fan is connected by 10-in. No. 18 galvanized-iron pipe, 90 ft. long, to an operating reverberatory furnace, sucking hot air (1,200° C.) through two fettling holes (area, 72 sq.in.) and delivering the hot blast (240° C.) through the center burning hole (64 sq.in.) of the furnace to be seasoned. Eighteen inches of brickwork was built between the fettling holes and the pipe, to avoid the latter being overheated; even so, it was red hot for a distance of 10 or 12 ft., indicating that heavier than No. 18 iron pipe might have been used to advantage, and that by insulating much higher temperatures could be delivered.

For the first 12 hr. the temperature was reduced by admitting cold air at the intake and adjustment of the control valve. Twenty-four hours of blast developed a warmth to all brickwork exposed; 48 hr. of blast developed a temperature that placed the brickwork beyond the sensitiveness that initiates unlimited trouble and extravagance. However, awaiting the completion of other work, the hot blast was continued for 10 days, at which time all brickwork was in excellent condition for rapid operation. As far as could be detected, the hot gases drawn out did not affect the operating furnace.

It can be utilized, as a time-saver, as soon as the furnace proper is in readiness, without affecting such work as completing flues, overhead steel workers, etc. However, its greatest advantages are temperate to reasonably high temperatures, under perfect control and uniformly distributed to all brickwork exposed.

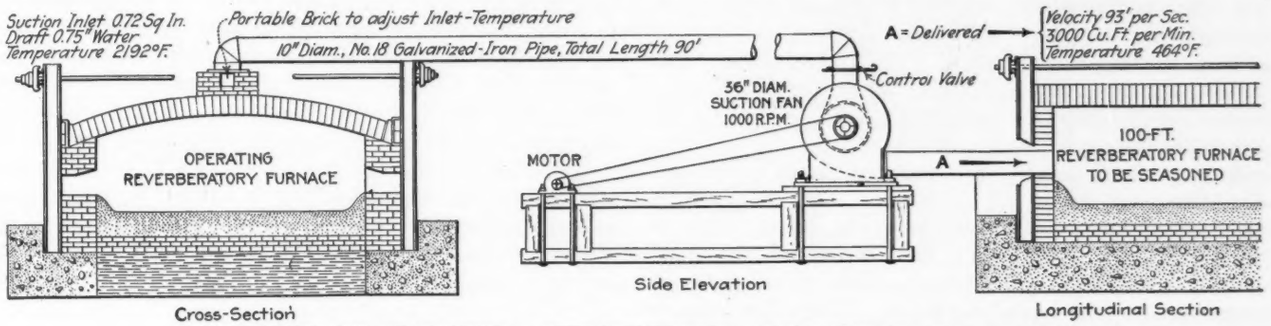
*Smeltery superintendent, Consolidated Arizona Smelting Co., Humboldt, Ariz.

This installation was utilized to great advantage to distribute uniformly the heat generated from the first wood and oil fires to the point of taking up the full expansion of the brickwork. The arch raised perfectly; the furnace bottom went into commission without the least trouble, and the furnace was doing service in four days and two hours after the first oil fires. While the excellent results obtained cannot be directly credited to this new means of seasoning, its influence was forcibly evidenced.

DATA OF SEASONING OF HUMBOLDT FURNACE

	Determined
Draft at inlet	0.75 in. of water
Draft at outlet	0.28 in. of water
Temperature at inlet	1,200° C. / 2,192° F.
Temperature at discharge	240° C. / 464° F.
	Calculated
Velocity at discharge	93 ft. per sec.
Air delivered	3,000 cu.ft. per min.

The equipment was entirely made up of pick-ups and is not necessarily confined to the installation shown. Its simplicity, economy and effectiveness recommend it for seasoning repaired or new reverberatory furnaces, even though it be necessary to build a crude temporary firebox from which the suction fan would draw all the smoke and heat into the furnace to be seasoned.



EQUIPMENT FOR SEASONING A NEW REVERBERATORY FURNACE AT HUMBOLDT

Engineers' Attitude Toward Preparedness

A resolution defining the attitude of engineers toward the policy of national defense was adopted by acclamation by an audience of about 1,000 engineers in New York City who are attending the series of lectures on military engineering at the United Engineering Societies Building. The resolution follows:

The engineers assembled in public meeting on Mar. 20, 1916, under the auspices of the Engineers' Committee on Military Lectures, believe that it is unworthy a great nation like the United States and that it is dangerous to the peace, safety and liberty of its people to remain in our present position of inadequate military, naval and industrial preparedness.

We believe that between pacifism and militarism there is a just, safe and proper ground, greatly in advance of our present position—a ground which involves large additions to both the navy and army, a large increase in our schools for training officers and a coördination and mobilization of the physical and industrial resources of the nation.

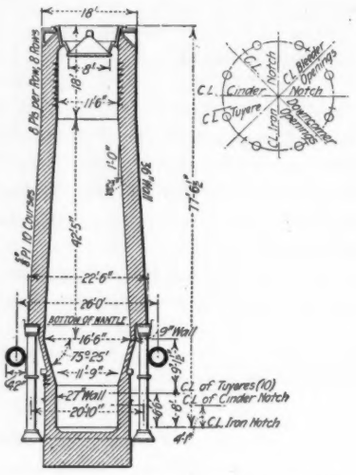
We believe that this nation should never make war except to enforce peace; that when strongly supported by armed resources its influence in maintaining its own liberties and rights and the liberties and rights of the weak and oppressed throughout the Americas will be greatly strengthened.

We believe that Congress should give due weight to the opinion of experts and should then appropriate sufficient money to put the nation in a position of defense against attack on either the Atlantic or the Pacific Coast. We demand that our representatives in Congress act in accordance with this expression.

Zenith Blast-Furnace Record

DULUTH CORRESPONDENCE

The accompanying drawing shows an iron blast furnace 16 ft. 6 in. at the bosh, 11 ft. 9 in. in the crucible and 75 ft. high. It was built 29 years ago by Mr. Birkinbine for the Zenith Furnace Co., Duluth, Minn., and was rated at 175 tons of pig iron per day. It had many vicissitudes and never produced that much good iron until within the last few years. A year ago this furnace, working on a burden of 25% old range nonbessemer and 75% Mesabi nonbessemer, was producing 204 to 215 tons of foundry pig per day and was making about 20 tons per day of flue dust. For five days in December last its record was as follows: For the week ended Dec. 11, 1,982 tons of iron was made, using 2,000 lb. of coke per ton of iron. The furnace is now averaging more than 300 tons, on 1,924 lb. of coke, of merchantable iron running 2.65 Si. There has been no change in the construction or lines of this furnace since it was originally built, except that in 1907 the bosh was



OLD ZENITH BLAST FURNACE

FIVE-DAY RECORD OF OPERATIONS

	Tons Iron	Pounds Coke per Ton Iron
Dec. 10	310	1,881
Dec. 11	289	1,904
Dec. 12	301	1,928
Dec. 13	307	1,910
Dec. 14	305	1,880

dropped 4 ft., but the furnace has been given air enough and the burden has been changed sufficiently, so that there has been plenty of air with no great waste in flue dust.

With the production of 300 tons per day, flue dust is running about 6 tons, or more than 50% less than when it was running formerly. The furnace burden now is 75%, Section 30, nonbessemer, (Vermilion hard ore) and 25% Mesabi. Thus, by a change in the metallurgical practice, the pig-iron production has not only been largely increased, but the flue-dust losses have been largely decreased, and all without appreciable increase in the coke consumption.

Another interesting fact in connection with this record is that Section 30 nonbessemer is very high in silica, running from 9 to 10%, and it was freely predicted that the furnace could never take care of the slag it would make when running on a large percentage of this ore.

The furnace is not running on prepared coke; it is running on run-of-oven Otto Hoffman byproduct, and it is not equipped with a Gayley dry blast, but merely has the air which the Lord provides in the Lake Superior country.

In the Classification of Zinc Dross, the Treasury officials have advised the Collector of Customs of New York that it is held to be different from spelter from which the dross is derived and is not entitled to free entry, under paragraph 404 of the existing tariff law, as American goods returned. This zinc dross is held to be dutiable at 10% ad valorem.

Bench Claims in the Yukon

BY J. A. MACDONALD*

In accordance with the terms of the Yukon Placer Mining Act, mining or placer mining includes every mode and method whereby earth, soil, gravel or cement may be removed, washed, shifted, refined or otherwise dealt with for the purpose of obtaining gold or other minerals. This includes bench claims, but it does not include the working of rock *in situ*.

Previous to the Consolidated Act of 1908 claims staked out beyond the lateral boundaries of creek claims were called bench claims. Such claims are confined in area to 250 ft. square. Fig. 1 represents a bench claim on Hunker Creek. The importance of accurate surveys of such bench claims may be inferred from the fact that a claim only 100 ft. square has yielded up to $80,000.

Ordinarily a placer claim must now be as nearly as possible rectangular in form and must be marked by two legal posts firmly fixed in the ground in a line parallel to a base line and on the side nearest to the creek or river toward which it fronts, and not more than 500x2,000 ft. Any person or persons locating the first claim on any creek, hill, bench, bar or plain, or locating a claim on any hill, creek, bench, bar or plain upon which there is no recorded claim, is entitled to a claim or claims respectively: One locator, one claim, 1,500 ft. in length; a party of two locators, two claims, each of 1,250 ft. in length; a party of more than two locators, two claims, each of 1,000 ft. in length, and for each member of the party beyond two

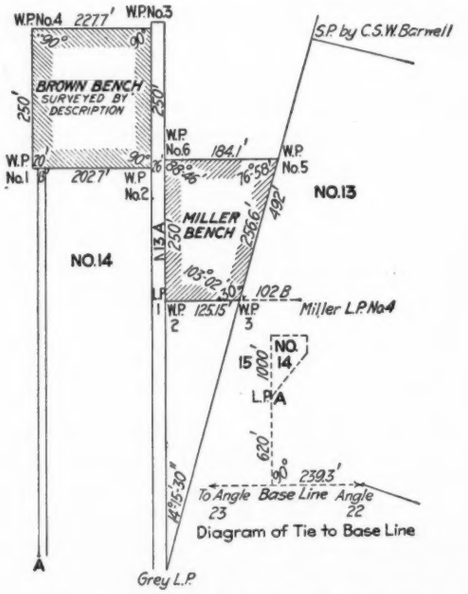


FIG. 1. LAYING OUT BENCH CLAIMS

a claim of the ordinary size—500 ft. The boundaries of any claim may, however, be enlarged, upon application by the owner, to the size of a claim allowed by the law if such an enlargement will not interfere with property owned by any other person or which is subject to the terms of an agreement with the Crown.

By this proviso owners of small bench claims have, in certain cases, the privilege of enlarging their claims from the regular 250-ft.-square size to 500x2,000 ft.

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Surveys of bench claims, on account of their small size, are necessarily very precise and accurate, as will be seen by referring to Fig. 1. The surveyor must be a duly qualified Dominion land surveyor, working under the direction of the Surveyor-General at Ottawa. The expenses in connection with the survey must be defrayed by the owners of the claims, but no fees are charged by the government for filing plans, etc. Any person having duly located a claim obtains a grant thereof for one or five years by paying to the mining recorder, in advance,

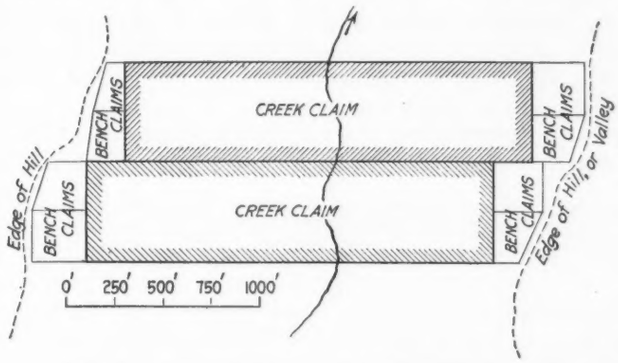

FIG. 2. AN ILLUSTRATION OF BENCH CLAIMS

the fees prescribed. Bench claims of the smaller area, on account of their small size or area and their necessary multiplicity, are no longer allowed. Under the present laws and regulations in the Yukon, all claims must be as nearly as possible of the regulation size.

There are, on Bonanza, Hunker, Last Chance, Dominion and other creeks, a large number of rich bench claims, that have made their owners wealthy. Of late, bench-claim owners have grouped their claims; that is, ten or more claims are grouped, or worked as one claim, under one organization or syndicate. In this way the necessary representation work can be done each year on the most important part of the group. Grouping has also been brought about in order to sell to the big companies, such as Yukon Gold, Treadwell, Bear Creek and others. These big companies have acquired, in the last few years, the majority of the bench claims. As much as $75,000 has been paid for a group of bench claims. Many good claims have, however, been sold to the companies at much below their intrinsic value, owing to the difficulties and expense of obtaining water on the benches for working the claims. Scores of bench claims have also reverted to the Crown for lack of representation work by their owners. These are usually quickly acquired by the big companies. Fig. 2 shows how those claims are laid out.

Safety and Welfare Work at Copper Queen

The physical examination of all applicants for work in the mining department of the Copper Queen Consolidated Mining Co., Bisbee, Ariz., was continued in 1915 and is credited in the annual report with having the effect of reducing accidents and sickness and increasing the efficiency of the working force.

In the mining department, in which the average number of employees was 1,883 in 1915, there were 2 fatal accidents, 2 involving permanent disability, 205 serious and 835 minor accidents. In the smelting department at Douglas there were 965 employees and 2 fatal accidents, 1 involving permanent disability, 36 serious and 149 minor casualties. The payments by the Copper Queen company to injured employees, under compensation law and otherwise, were 1.2% of the payroll, or $41,027.

The amount paid to old employees, last year, under the pension rules was $11,125. Applications were granted for nine new pensions in 1915, making a total of 25 pensions now being paid. Of the American employees of the company, 76.3% are members of the Employees' Benefit Association. This percentage is considered satisfactory, as a proportion of the nonmembers are unable to join the association because of physical condition. Last year the association paid in benefits over $43,000. In the hospital department over $87,000 was spent for maintenance and the receipts from fees were $81,000. Hospitals are maintained at Bisbee and Douglas.

United Verde Extension

By Walter X. Osborn*

A few months ago, a development drift was started south from the Edith shaft on the 1,400-ft., or bottom, level of the United Verde Extension mine, at Jerome, Ariz. In January of this year a crosscut was run from this drift, and it broke into a body of enriched chalcopyrite ore. Since that date the south drift has been extended about 275 ft., all of which is in ore. Crosscuts have been run at intervals of 50 ft., and so far have proved the orebody to have an average width of about 150 ft., without, however, having encountered the east wall of the ore in the southernmost crosscuts. Of the two raises one is now up 70 ft. and is still in ore. A winze in the orebody, to go to a depth of 200 ft., has been started.

There is now developed a body of copper ore of an average width of 150 ft.; the longitudinal extent of the ore is still unknown, but it exceeds 275 ft. The orebody is a massive siliceous chalcopyrite, enriched with chalcocite, and will average through the entire body about 15% copper, 1½ oz. silver and $1 in gold per ton. This orebody is now sufficiently developed to give to the United Verde Extension mine the promise of being a producer of great wealth. It is still being developed in a careful and conservative manner, and only the future can tell what the extent of the orebody will really be, especially in depth. From development work, ore containing about 2,000,000 lb. of copper was shipped, in two grades, of 15% and 30% respectively, to the Copper Queen Consolidated Mining Co.'s smelting works during the month of March, and this production will probably be increased.

Work on the United Verde Extension property was first begun in the year 1900 and over $300,000 was spent prior to the reorganization undertaken by the present company. Since December, 1912, when the last development campaign was started, over 20,000 ft. of development work, including work done in the Jerome Verde ground, was done before the present extraordinary body of ore was encountered at a depth of over 1,300 ft. from grass roots and at a distance of over 2,000 ft. from the original Daisy shaft. In this section there can be no easy "finds"; discovery of orebodies requires long and persistent effort and heavy expense.

*Consulting engineer, United Verde Extension Mining Co., Box 888, Douglas, Ariz.

Mt. Morgan Metallurgical Notes

The report of the Mt. Morgan Gold Mining Co., Ltd., for the half-year ended Nov. 28, 1915, shows that the effects of the war have extended even to copper-smelting enterprises in Australia. Owing to the dearth of basic lining, the converting department at Mt. Morgan was greatly inconvenienced and forced to revert to acid lining for a time. It was thought that the shortage in magnesite brick would be overcome by the middle of December, but the new shipments received proved inferior and practically useless for the work. The Edwards furnace used in connection with the pot-sintering plant did not work out as satisfactorily as expected, the products of the preroasting furnace being unsuitable for pot sintering. A shipment of Mt. Morgan flotation concentrates was sent to the Cockle Creek works of the Sulphide Corporation and tested in the rotary furnace there. As a satisfactory product for sintering in pots was obtained, these furnaces will be used at Mt. Morgan. The Dwight-Lloyd sintering plant, treating concentrates and flue dust at Mt. Morgan, worked as usual during the half-year.

Smelting costs showed a considerable increase owing to the more siliceous ores and the high clay content of the concentrates. Two furnaces were run continuously during the period, except for the loss of five hours owing to power interruptions. A matte gravity system was installed to relieve the cranes in the handling of the large quantities of matte.

The recoveries in the concentrator during the half-year were 88.49% of copper and 72.58% of the gold. The gold recovery compares unfavorably with the preceding period, this being accounted for by the use of ore from that section of the mine known as the Old Gold stopes, where the metal is in a very fine state, closely associated with silica and is carried off with the tailings. The recovery of copper by tabling was 31.89% and by flotation 56.60%, making up the total of 88.49%, as noted.

Expediting Land Patents

The difficulty of obtaining patents to mineral claims has been a subject of much complaint during the past few years, so that the efforts of the Secretary of the Interior to improve conditions have been highly appreciated as shown by the following resolution, which was adopted by the Northwest Mining Convention:

A resolution recognizing efforts of Hon. Secretary of the Interior and Hon. Commissioner of General Land Office in expediting patents.

Whereas, It is common knowledge in the mining industry that for the past eight or nine years the process of securing United States patents to mineral claims has been slow, cumbersome and expensive, and much beyond the reasonable time and means of the prospector or the young mining company to finance, and

Whereas, such process has within our knowledge seriously impeded mineral discovery on the public domain, and

Whereas, it has come to our knowledge that the Hon. Franklin K. Lane, Secretary of the Interior, and the Hon. Clay Tallman, Commissioner of the General Land Office, appreciating this state of facts, have succeeded in materially reducing the length of time required for securing patents, greatly to the benefit and encouragement of prospecting and mining.

Be It Therefore Resolved, that this convention, in mass, assembled, express its deep appreciation of the efforts of both the Hon. Secretary of the Interior and the Hon. Commissioner of the General Land Office in behalf of expeditious and businesslike methods in the issuance of mineral patents.

Be It Further Resolved, that copies of this resolution be transmitted to the Secretary of the Interior and the Commissioner of the General Land Office.

Signed by the Resolutions Committee.

Read before the Convention, unanimously adopted this 24th day of March, 1916, and the secretary is instructed to transmit copies as indicated above.

Safety-First in Lifting

The accompanying illustrations, reproduced by courtesy of the *Ingot,* the safety-first publication of the Raritan Copper Works, show the way to avoid injuries by improper lifting. Fig. 1 shows the wrong way to lift. All the strain comes on the lower part of the back where the muscles are the weakest. If the load is heavy, either strain or rupture may result.

Fig. 2 shows the right way to lift. This man is bending at the knees instead of from the hips. Back should be kept as nearly straight as possible with shoulders directly over the feet. The strain now comes on the shoulders and thighs, which are strong and not so liable to be affected by the weight.

FIG. 1. THE WRONG WAY FIG. 2. THE RIGHT WAY

British Sulphuric-Acid Prices

The Minister of Munitions, according to *Journ. Soc. Chem. Ind.,* Feb. 29, 1916, fixed the following maximum prices per ton for sulphuric acid delivered into railway trucks, carts or barges at makers' works:

Class	Degrees Twaddell	£	s.	d.
A. Arsenical acid	140	3	0	0
B. Dearsenical acid	144	3	15	0
C. Arsenical acid	168 (93—95% H_2SO_4)	5	15	0
Dearsenical acid	168 (93—95% H_2SO_4)	6	0	0

Incidental charges are also to be regulated so that when the acid maker supplies the tank-trucks he shall be entitled to make a further charge of not more than 5s. per ton for filling and hire of tank-trucks. Also when the acid maker supplies the acid in his own drums, he shall be entitled to make a further charge of not more than 10s. per ton for filling and hire of drums.

Publication of the Following Maps, announced by the United States Geological Survey, will be valuable to those who are interested in the districts in question: California—Maine Prairie, Mare Island and Saxon Quadrangles (price 10c. for each); Nevada—Ely and Manhattan Quadrangles (price 10c. each); Oregon—Escacada Quadrangle (price 10c.). Use of these maps is growing and the Survey welcomes the additional demand.

Mining in British Guiana*

SYNOPSIS—Diamond mining and gold dredging flourished in British Guiana last year, but hand sluicing, hydraulicking and quartz milling were at low ebb. Commissioner Fowler suggests that dredging of hand-worked gravel offers opportunities on some of the larger creeks, such as Arakaka on Barima River.

The gold-mining industry, although not in as flourishing a condition last year as in 1913-1914, still produced the fair amount of 64,982 oz.—a decrease of 17,724 oz. This industry was little affected by the European War. There was a temporary stoppage in the shipment of gold from the Colony, but matters soon returned to the normal with an increase in shipping charges and war-rate insurance.

Comparative statements of the gold production of the Colony and of the various districts during the last two years are given in Table 1. Two districts show an increase—Mazaruni of 12,392 oz. and Potaro of 7,535 oz.; all the other districts show decreases. The increase in Mazaruni was due to the workings on the Kaburi Creek, where the activity continued throughout the year. The increase in Potaro is largely due to the fact that gold brought from the Konawaruk district is now placed under that head instead of Essequibo as formerly.

TABLE 1. GOLD OUTPUT OF BRITISH GUIANA—By Districts

Districts	1913–14 Oz.	1914–15 Oz.
Barima	10,311	7,975
Barama	2,513	1,303
Cuyuni	38,967	11,028
Groete	80	44
Waini	.....	3
Puruni	688	383
Mazaruni	10,381	22,773
Essequibo	7,322	1,502
Potaro	12,433	19,968
Demerara	7	.....
	82,706	64,982

Marked Decline in Sluicing Operations

The decreases in Barima and Barama are due to the more or less exhausted state of the placers in those localities, with the consequent diminution of working operations. A decrease of 19,456 oz. in the yield from sluicing operations is due almost entirely to the smaller amount of gold produced by the Pigeon Island placers, Cuyuni River, owing to their desertion by the large number of men who had flocked to that locality during the previous year. The claims in the Kaburi district continued to employ a large number of men, and rich finds were made in Ohio Creek. An immediate result of such finds was a dispute as to the ownership of three claims, in connection with which dispute 1,288 oz. of gold was detained for over eight months pending the hearing and subsequent appeal to the supreme court. The warden's decision was reversed by the court and the gold awarded to J. A. E. Small, by whose laborers it had been washed in 21 days. In Tiger Creek, Potaro, systematic washing operations were carried on by F. W. Hutson with about 200 registered laborers. Damming the creek and digging a canal about three-quarters of a mile in length has insured a water supply for a year's work at least.

E. E. Winter, warden of No. 2 mining district, has made the following report:

> On the Ho-a-Shoo claims in the Eagle Mountain section the tributers are following leads of pay gravel under the heavy covering of clay. Similar work is being done on some claims in the Konawak section. I find it impossible to get from the tributers any statement of the returns. They must be good, however, because the men cheerfully work for weeks on the preparatory deadwork without any return at all, while during this time the shops readily give them credit.
>
> In many places along the Eagle range, up to the Konawaruk branches, the tributers are taking out auriferous quartz and pounding it. On the Ho-a-Shoo claims at Look and Weep, at the head of Deer Creek, the mountain side is simply riddled with small tunnels, while shallow shafts, roughly timbered and with windlasses at the top, are seen here and there. Some of this quartz is exceedingly rich. Pieces I saw, no doubt carefully selected, carried as much gold as quartz. The tributers carefully conceal any good returns, so as to prevent others from taking up positions near them. It is not possible, therefore, to give figures at present. One return of 45 oz. to a barrel of quartz, however, was generally agreed upon. This would be a probable return from some of the quartz I saw.
>
> Similar work is being done by J. F. Clement at the head of the Winiperu Creek, left bank of Konawaruk, and by Maynard and de Hart on lower Konawaruk, near the Mowasi divide. In the Omai section a few men are sinking shafts on the left bank of Dunclain Creek and working at a thin vein of quartz encountered at a depth 15 to 20 ft. When the quartz around the bottom of a shaft is worked out, another shaft is sunk 40 or 50 ft. away. No drifting is done.

Hydraulicking at the Tassawini mine, Barama River, was discontinued and no gold was reported as having been produced from this source during the year. The warden of No. 2 mining district, Potaro however, reports as follows:

> On the lower slopes of Look and Weep, and on the Mahadiana and Konawak Creeks, a crude system of hydraulicking is being used by the small claimholders and tributers. Water, of which there is a good supply in the district, is led to the top of the ground to be worked and made to cut a deep canal through the middle of it and down into the clay below the gravel. The water is then directed from one side to the other until all the ground has been washed through the canal, across which riffles of small stones are placed to catch the gold. No instrument is used, and when conditions are favorable, an hour's work every day is enough to keep the system going. The cleanup is made off the clay bottom of the canal.

The quartz mill at the Peter's mine, Puruni River, was put in operation for a few days in March, 1915, by the representative of a prospective purchasing company and 108½ oz. of gold cleaned up, which, however, was not brought to Georgetown until after the close of the financial year. The Aremu mine, Cuyuni River, and the Barima mine on the Arakaka Creek, on the right bank of the river from which the mine takes its name, remained closed down throughout the year.

Dredge Yield Greatest in a Decade

Dredging was actively carried on by the Guiana Gold Co. and the Minnehaha Development Co. in No. 2 Mining District with satisfactory returns. There is, according to Commissioner Fowler, large scope for gold dredging in British Guiana, as many of the larger creeks that have been already washed with the tom and sluice would pay to rework with a dredge. An example is the Arakaka Creek, Barima River, which is conveniently situated for the transportation of the necessary dredging machinery.

The Guiana Gold Co. operated with four dredges throughout the year and paid royalty on 8,170 oz. of

*Excerpts from annual report of Frank Fowler, commissioner of lands and mines, Georgetown, Demerara, British Guiana.

bullion. General Manager J. Henderson gives some details of the last year's results in Table 2.

TABLE 2. DREDGING RESULTS—GUIANA GOLD CO., LTD.

Name of Dredge	Gold Won Oz.	Dwt.	Gr.	Material Treated, Cu.Yd.	Average Value, C. per Cu.Yd.	Length of River Worked, Mi.
Lady Mary.....	1,662	2	10	276,314	12.5	½
Lady Maud.....	1,836	10	2	190,292	19.9	½
Lady Bertha.....	2,991	17	18	133,833	46.2	½
Lady Anne.....	1,851	12	11	272,674	14.0	Various places

"Lady Mary" and "Lady Maud" worked mostly in ground composed of fine material, heavy clay overburden treated where banks were worked. "Lady Bertha" worked very rough and rocky ground for the greater part of the year. "Lady Anne" worked through several rocky patches, but most of the ground was similar to that worked by "Mary" and "Maud." Delay caused in removing "tacoubas," found embedded in river and banks, made good working time impossible on any of the dredges.

Gold won by "Mary," "Maud" and "Anne" ranged from medium to fine; the "Bertha's" gold was mostly medium, but in places coarse gold and small nuggets were found.

The Minnehaha Development Co. operated two bucket dredges—one on the Minnehaha Creek and the other recently erected on the Mahdia Creek. The bullion produced by these dredges was 4,438 oz., a considerable increase on the last year's production.

Yield of Diamonds Was Large

The diamond industry was most adversely affected in the latter part of 1914 by the war; the European market for diamonds having ceased, the local banks discontinued giving advances, and the industry practically came to a standstill in December. The workings in the Mazaruni River had opened briskly in April, and good returns were obtained up to the time the adverse market conditions arose. Notwithstanding, the output was 100,522 stones, weighing 13,716½ carats, the largest production in any one year, being an increase in quantity on 1913-14 of 2,597 carats. The stones averaged 7.32 to the carat, an improvement in size on those won the previous year. The Mazaruni Co., Ltd., has a 50-year concession for diamond mining on certain tributaries on the left bank of the Mazaruni River.

The committee on diamond-mining regulations recommended an increase in the claim rental and a supertax on diamond production.

Prospecting for bauxite was carried out in the upper Demerara and deposits located. Quarrying titles were applied for on the Colony lands at Christianburg and Wismar and Crown lands at "Three Friends" on the right bank of Demerara River, and on the left bank of the same river, which applications were still under consideration by the government at the close of the year. An American company acquired, from private individuals—in some cases the freehold and in others the mining rights—to 13,000 acres in the Demerara River.

There were 2,931 laborers registered in the gold-mining fields, and the health of the men was considered good, only 16 deaths being reported. These were classified as follows: Natural causes, 13; accidental, 1; gunshot wound, 1; cause unknown, 1. In the past, aside from "natural causes," more men have lost their lives by drowning than any other one cause; during the last year, no deaths were reported from this source.

Prospecting licenses to the number of 488 were issued, compared with 1,096 during the previous year, which was an abnormal one owing to the rush to the Pigeon Island and Kaburi districts. The number issued in 1914-15, however, was in excess of those issued during each of the four years prior to 1913-14. During last year, 369 claim licenses were issued as against 619 the previous year, and 455 claim licenses were revoked.

Interpretation of Assay Curves for Copper Drill Holes*

In the exploration of a copper deposit by drilling, obvious advantages are to be gained from a distinction between primary and secondary ore.[1] Perhaps the chief of these is the aid that such a distinction renders in determining where a given hole should stop. The copper assay, often a sufficient guide, cannot always be exclusively relied upon. Primary ores may extend downward indefinitely and may fluctuate in value independently of depth; if primary ores are consistently lean for a considerable vertical distance, there is little reason to expect that, still deeper, their mineral content will increase to the commercial grade; on the other hand, rich primary ores may persist uninterruptedly downward or may come in again below a lean interval. Secondary ores, however, have a comparatively limited vertical extent; in the large way enrichment decreases with depth and finally gives out. It follows then that when a hole descends from profitable ore into ore of less than the commercial grade, the practical significance of the situation depends upon whether this decrease in mineral content results from a decrease in secondary enrichment or is a variation in primary content. If the valuable minerals passed through have been chiefly secondary, little is gained in the average case by extending the hole much below the point at which the commercial limit is reached; but when they are chiefly primary, due weight must be given to the possibility that, still deeper, the assay value may again increase.

The distinction between primary and secondary ore may of course be effected through an examination of the drillings. It has been found, however, to be facilitated by curves made by plotting assays against depths. In this connection, the data of several hundred drill holes in the copper districts of Ajo, Bingham, Bisbee, Ely, Miami, Ray and Santa Rita have been studied, in conjunction with the corresponding drill pulps and ore specimens. The accompanying curves represent holes chosen to illustrate both normal and abnormal conditions, which are respectively simple and difficult of interpretation.

Conditions Most Commonly Encountered

The significant features of curve shape are chiefly concerned with the abruptness of the change in copper content. In particular a jagged profile is to be contrasted with a smoother one, and according as they possess one or the other of these characters, curves representing normal conditions fall into two principal groups:

Group I. That in which the tenor undergoes no abrupt change throughout the sulphide part of the hole; for example, Curves 1, 2 and 3.

Group II. That in which the lower part of the curve has the characteristics of Group I, while the upper part is richer and is marked by peaks; for example, Curves 4 to 8.

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*Excerpts from a paper by Edward H. Perry and Augustus Locke, read before the New York meeting of the American Institute of Mining Engineers, February, 1916; this is one of a series of contributions by the Secondary Enrichment Investigation and is intended to present results of specific portions of its work in advance of the complete memoir.

[1]In this paper the terms "secondary" and "enriched" are used in the sense commonly ascribed to them in the expression "secondary enrichment" and refer to changes undergone by initial—that is, primary—constituents of an ore as the result of solutions descending from the surface. The term ore as here used does not necessarily signify material of commercial grade, and consideration is given only to sulphide, not to oxidized ores.

Primary ore commonly yields a curve of mild profile. A curve of secondary ore is usually peaked, and as might be expected, the more emphatic the enrichment the higher and rougher are the peaks and the more characteristic is the form of the curve. A curve, then, of Group I presumably means primary ore, while a curve of Group II presumably means primary ore below secondary ore. The curves noted as illustrating these two groups are, in fact, exactly what their forms thus suggest.

In Group I, Curves 1 and 2 well exemplify, by the smoothness of their profiles, the comparatively uniform tenor of primary ores under conditions defined as normal. They also illustrate a not unusual tendency of primary ore to decrease gradually in value with depth. Curve 3 indicates a somewhat less constant grade of ore, yet sufficiently uniform to place the curve in Group I; in any case there is nothing in its shape to suggest enrichment. This curve further serves to illustrate a condition not very common—increase in metal content with depth.

In Group II, Curves 7 and 8 bring out strikingly the effect of strong enrichment on low-grade primary stuff; in Curves 4 and 5, though the primary ore was of better grade and the ratio of enrichment somewhat lower, the effect of enrichment is clearly shown by the distinct difference in character as well as in tenor between the upper and lower parts of the curves; in Curve 6 good primary ore, not very strongly enriched, yields a profile less strikingly different in its two parts, though even here the situation is plain. In all these five curves the conditions are to be regarded as normal.

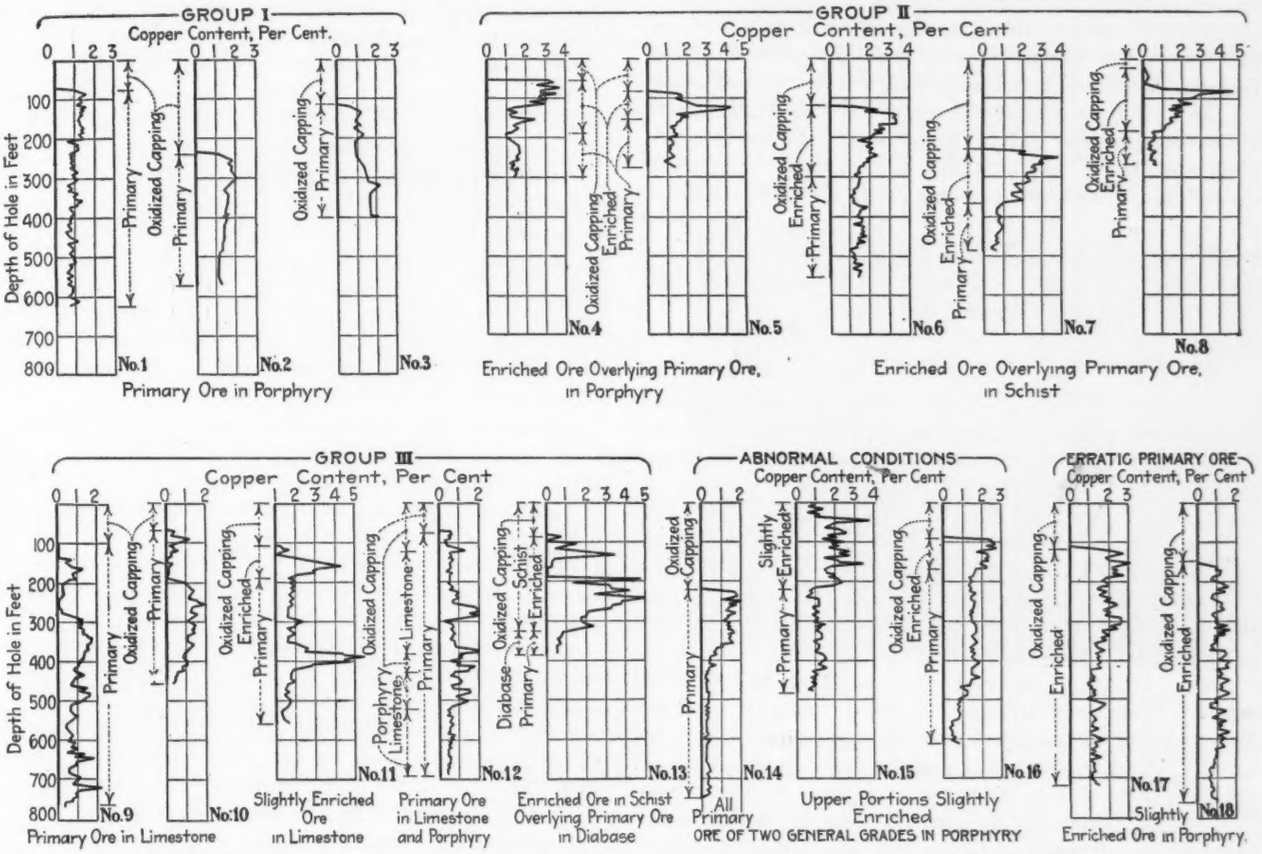
Fortunately these two types of curves, generally easiest of interpretation, are the ones most commonly encountered.

An interpretation of ore character, however, by means of curve shapes alone is often beset with difficulties. Departures from normal conditions may be encountered in porphyry or schist, but are met most frequently in other rocks. They are most likely to be found in limestone, which is fairly common in deposits explored by drilling, and which, on account of the erratic nature of its mineralization, often introduces disturbing factors. Various kinds of difficulties that are experienced find illustration in Curves 9 to 13, which may be classed as still another group:

Group III. That in which decided irregularities occur once or more, without systematic relation either to each other or to the top of the hole.

Curves 9 and 10, representatives of a type that is common, are of primary ore in limestone. If they were in schist or porphyry, their moderately peaked character extending to the bottom would suggest deep and rather mild enrichment. Curve 9 serves to illustrate also how the copper assay alone might lead to an erroneous decision as to the depth at which the hole should be bottomed. On the basis of copper content alone, the hole might have been stopped at a depth of 170 ft. or at a depth of 600 ft.; if the decline in tenor just above either of these horizons had been due to a playing out of enrichment, bottoming at one or the other of these depths would have been justified, but since the ore is in fact all primary, it was wise to sink the hole sufficiently deep to establish with reasonable satisfaction that good ore was not to be expected.

Curve 11 is of slightly enriched ore in limestone. The existence of two peaks widely separated is not typical



COPPER DRILL-HOLE ASSAYS CHARTED WITH A VIEW OF DETERMINING WHEN DRILLING SHOULD BE STOPPED

of enrichment in schist or porphyry and suggests primary ore with erratic or bunchy distribution of the copper minerals, and this in turn suggests limestone. The two peaks in the curve might, for example, coincide with two of the limestone beds that were especially favorable for primary-ore deposition. As a matter of fact, were the effect of enrichment removed from this curve, its shape would be only slightly changed. This situation well illustrates the impossibility of detecting enrichment in limestone from the shape of the curve alone.

Curve 12 is of primary ore in alternating porphyry and limestone. It has the appearance of being a typical curve of primary ore in limestone, but there is no way of determining from its shape whether or not enrichment is involved in any part of it.

Curve 13 is of enriched ore in schist overlying primary ore in diabase. Altogether, the curve looks like one in porphyry or schist with irregular enrichment above primary ore; the barren stretch near the middle of the hole might be variously interpreted as the result of leaching or as due to primary poverty, and the small length of low-grade at the bottom might suggest a return to primary conditions. As a matter of fact, the low-grade at the bottom is due to the presence of the diabase into which the enriching solutions were unable to penetrate effectively, and the barren interval is the result of oxidizing influences, which have entered obliquely or laterally, and have thus undercut sulphides lying above.

Erratic Conditions in Porphyry and Schist

Abnormalities that are occasionally present in deposits contained in porphyry or schist may bring about conditions as difficult of interpretation as those due to the presence of limestone or of other disturbing rocks, or they may yield curves which, on the basis of shape, would fall in Group II or even in Group I, but which in reality owe their shape to causes other than those normally determining the profiles characteristic of Groups I and II respectively. Curves 14 to 16 afford examples of such erratic or abnormal conditions.

Curve 14 is of primary ore in porphyry. Viewed broadly, it suggests enriched ore over primary ore; yet its upper and richer part lacks the strongly serrated outline usually found to accompany enrichment. Indeed, each of the two parts, taken independently, looks primary, and this, indeed, is actually the case, the drop in tenor coinciding with the entrance of a porphyry of a different variety which, in the district in question, carries less copper.

Curve 15 is of ore in porphyry, only slightly enriched and representing two primary grades, the poorer underlying the richer. The primary copper of the poorer is in chalcopyrite; that of the richer is in bornite as well as chalcopyrite. On the basis of shape, the curve is an especially good example of Group II, which would ordinarily signify enriched ore overlying primary ore; yet in this particular case, the effect of enrichment on the shape of the curve is only to accent the relief of the peaks in its upper, richer part.

Curve 16, of ore in porphyry, might be thought to indicate deep enrichment giving way to primary ore near the bottom. As a matter of fact, enrichment is confined to the upper part, where the irregularities are most accentuated; below the point, at a depth of about 170 ft., where the tenor suddenly steps down and the curve becomes smoother, the ore is wholly primary, growing distinctly leaner near the bottom.

Curves 17 and 18 are in porphyry and are slightly enriched throughout. They are not to be regarded as abnormal; they represent a normal condition that yields a somewhat erratic curve. Nothing in their shape, however, distinguishes them from curves of primary ores of somewhat variable grade in porphyry or schist.

Character of Ore Is Not Determinable by Assay Curves Alone

After all, there are a number of varieties of knowledge, not yielded by curves, which are essential to an intelligent diagnosis of conditions. The study of curve shapes must be made in the light of an understanding of the geologic habits of the district. A knowledge of the kind of rock traversed is invariably required, and there must always be enough study of drillings and of other specimens to yield an intimate acquaintance with the district habits.

Such studies are facilitated by the microscope. Thin sections are sometimes necessary for the identification of the rocks and determination of the alterations they have undergone. Polished surfaces of opaque minerals are often indispensable for the recognition of enrichment and of its character. Powders, such as drill pulps, can be investigated by the microscope or by the binocular, a magnetized needle aiding in the separation of magnetite from chalcocite, which, in the powdered form, it closely resembles. It is often advantageous to embed powders in sealing wax, in order that polished surfaces of their constituent grains may be prepared for microscopic examinations.

Limestone—which it is especially important to recognize on account of its disturbing influences—is sometimes difficult of identification because of intense alteration. The common test of effervescence with acid may of course be ineffectual, because of the frequent destruction of the carbonate by the alteration. A familiarity with the conditions or character of limestone alteration in the district will usually serve in separating this rock from porphyry. The limestone, however much altered, is likely to have a characteristic aspect, due, for example, to certain habits of sulphide aggregation or of softness.

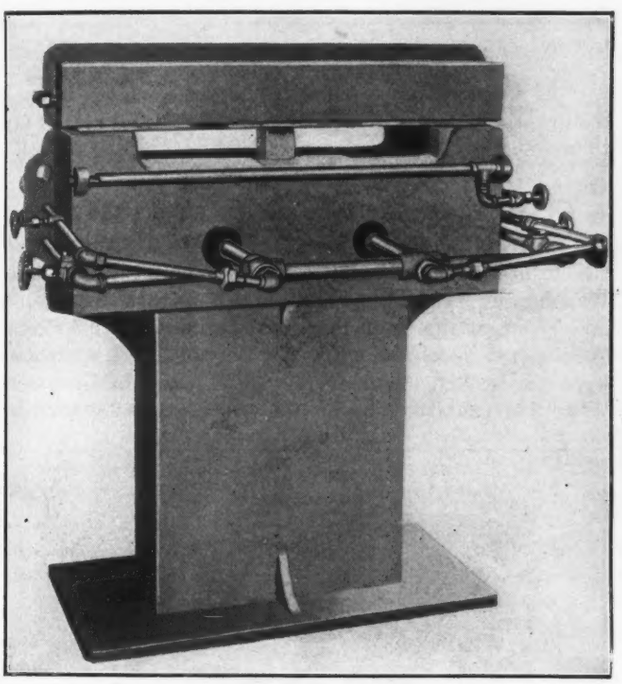
Altogether, the usefulness of a study of curve shapes will vary inversely with the amount of additional knowledge needed for their interpretation. Should the deposit or district be erratic in its habits, curves may not be very intelligible. But should the district possess a uniformity or regularity in its general geology and its mineralization, the curves are likely to be very significant and to constitute an important shortcut to an understanding of the ore distribution.

A Siberian Bureau To Foster Siberian Industries, was recently established, according to the "Russian-American Journal of Commerce." Such a bureau was made necessary by the removal from Poland and the Baltic Provinces of mills and factories to Siberia. The bureau is taking measures to promote the metallurgical industry of the North. It is organizing a scientific expedition to make a thorough investigation of the mineral resources of the country, especially iron and coal, to determine the quantities of iron used in Siberia in the form of tools and hardware, and to study the growth and development of the iron industry in Siberia. The expedition, which will start in the very near future, will be composed of 16 engineers, metallurgists, chemists and geologists for field work and 7 engineers for laboratory work. To cover the cost of the expedition, 360,000 rubles has been advanced as a first grant.

Mining & Metallurgical Machinery

Ajax Oil or Gas Forge

The Ajax oil or gas forge is a new departure, since it is two forges in one, having two burners and two fireboxes. When used as one complete unit it will heat drill steels fast enough to keep two drill-sharpening machines in fast operation. One side of it may be used for heating steels for sharpening and the other side for tempering. During hours when comparatively few steels require sharpening, an economy of fuel may be effected by using only one burner to heat 5 to 8 drills, which is only ¼ the total capacity of the forge. Since it is never desirable to heat



AJAX OIL OR GAS FORGE

a steel for more than 3 in., the Ajax forge is made wit its firebox 2½ in. deep. In making collars or lugs, how ever, the heat can be placed where desired. This forge i being put on the market by T. H. Proske, Denver, Colo

Mining Machinery in Russia

According to a recent number of the Board of Trade *Journal,* the British vice-consul at Ekaterinburg reports that a serious lack of machinery is beginning to be felt. Apart from any new enterprises, the machinery in use is likely to be scrapped, owing to the difficulty of obtaining spare parts, so that practically all existing enterprises must replace their machinery after the war.

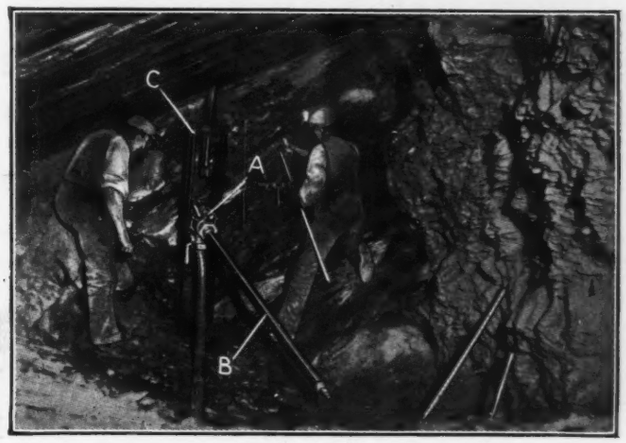
There is a tremendous demand for catalogs and specifications printed in the Russian language. In trying for business there American firms should heed the advice given by Vice-Consul Preston to send representatives having a good knowledge of the Russian language.

The Kellow Rock Drill

The Kellow rock drill, which is reported to have made some remarkable records in drilling in copper mines in Spain, is a rotary boring machine, adapted to underground work, which will bore holes from $1\frac{3}{16}$ in. to 3 in. diameter; the former, it is claimed, at a rate of 7 ft. 6 in. in 1½ min., and the latter at the rate of 30 ft. per hr.

The cutter is rotated against a rock face under heavy hydraulic feed pressure, which the manufacturers claim is, under the circumstances, more efficient than pneumatic. Where a direct head of water is not available, a compact self-regulating pump is furnished.

The principle of action of this drill is a turbine wheel driving the drill rod through epicyclic gears. The feed and return are automatically obtained by hydraulic pres-



THE KELLOW DRILL UNDERGROUND

sure. The exhaust water is brought back by utilizing its residual velocity, leaving the turbine vanes on the Venturi principle. The water passes to and from the machine in concentric hose pipes, which are connected to the drill by a single union. Two jets of high-pressure water, applied directly to the cutting edges of the bits, effectively clear the débris and allay all dust.

The drill is supported for tunnel work by means of setscrews engaging in the sides of the machine and resting in a double column. When required to be fixed high on vertical rough faces, or in a position in which the use of a column is impossible, the machine is supported on screwed rods.

In the construction of the drill the moving parts are especially designed, and it is claimed that they are mathematically correct as to details of turbine principles. All of the moving parts run in an oil bath and are constructed of chrome-vanadium steel. The casing completely isolates the drill rod from any of the working parts of the machine, so that no grit or clay can possibly pass into the mechanism.

The drill rod is hexagonal and is made an easy fit in the drill-rod casing or sleeve. It is screwed left-handedly

at its inner end to fit the piston, and right-handedly with a triplex or quadruplex thread at the outer end to receive the cutter holder, or socket. The multiple thread is adopted in consequence of the enormous torque that has to be transmitted by the rod. The drill rod is hollow to enable water to pass down through it to the cutting tool. The feed cylinders can be supplied in any length, 5 ft. and 7 ft. 6 in. being the most common. The length of the feed cylinder determines the length of the hole.

The following drilling records were made at a Spanish copper mine with a drill boring a 3-in. hole, which it is claimed maintained its gage throughout the length of the hole. For slate rock traversed by quartz veins the following record of time and drill speed was made:

	Minutes
Average time taken per hole in setting up	53½
Average time taken per hole in drilling, including time taken to connect and disconnect extension rods and to exchange cutters	38
	Ft. In.
Average depth of each hole	24 6
Average length bored per hour, including time of drilling, connecting and disconnecting extension rods and exchanging cutters	38 3

In hard mineral-bearing rock and extremely hard and compact siliceous rock, at the same mine, the following records were made:

	Minutes
Average time taken per hole in setting up	37
Average time taken per hole in drilling, including time taken to connect and disconnect extension rods and to exchange cutters	45
	Ft. In.
Average depth of each hole	19 2
Average length bored per hour, including time of drilling, connecting and disconnecting extension rods and exchanging cutters	26 9
Average length bored per hour, including time of drilling, connecting and disconnecting extension rods and exchanging cutters in extremely hard siliceous rock	5 6
Average length bored per hour, including time of drilling, connecting and disconnecting extension rods and exchanging cutters in ordinary mineral rock	30 0

This rock drill will be manufactured for the Kellow Rock Drill Syndicate, Ltd., Keldril Works, Croesor, Penrhynbeudraeth, North Wales, by Holman Bros., rock-drill manufacturers of Camborne, Cornwall, as soon as this firm, now fully engaged in the manufacture of war munitions, can find opportunity to do so.

In the illustration *A* is the drill head containing the turbine mechanism, *B* is the feed cylinder and *C* is the setscrew double-column or mounting.

Operation of Engine-Driven Electrolytic Generators

The following table gives the number of hours of operation and the percentage of time that generators were in service at the Raritan Copper Works, Perth Amboy, N. J., from August to December, 1915.

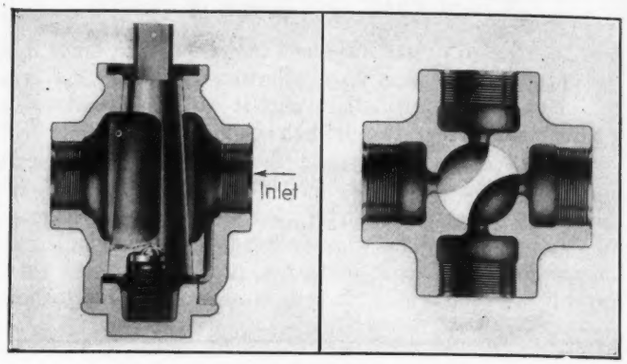
Month	Total Hr. in Month	Engine No. 1 Hr. in Operation	Engine No. 1 Percentage	Engine No. 2 Hr. in Operation	Engine No. 2 Percentage	Engine No. 5 Hr. in Operation	Engine No. 5 Percentage	Engine No. 6 Hr. in Operation	Engine No. 6 Percentage	Percentage Total all Engines
Aug...	744	622.00	89.0	575.25	77.0	740.25	99.7	739.00	99.2	91.5
Sept...	720	719.50	99.9	705.25	98.0	703.00	97.6	715.00	99.4	98.6
Oct....	744	713.00	96.0	718.00	96.5	726.50	97.5	724.50	97.5	97.0
Nov...	720	691.25	96.1	698.00	97.0	696.00	97.0	683.60	95.0	96.0
Dec....	744	732.60	98.5	733.25	98.5	740.50	99.8	742.25	99.9	99.0
	3,672	3,518.35	96.0	3,429.75	93.4	3,606.25	98.5	3,604.35	98.2	96.4

The engines are four-cylinder triple-expansion corliss 21, 38, 44&44x48-in. driving 900-kw. generators and were built by the Nordberg Manufacturing Co., Milwaukee, Wis. The engines, as noted in the table, operated in most cases over 95% of the time, averaging out of the total time in five months 96.4% continuous operation. The time lost was for the most part in keying up and taking up lost motion in valve gears.

The chief engineer of the Raritan Copper Works is George L. Fales, to whom a large share of the credit for this operating record is due.

Crane Co. Four-Way Valve

The accompanying illustrations show a neat type of balanced four-way valve recently introduced by the Crane

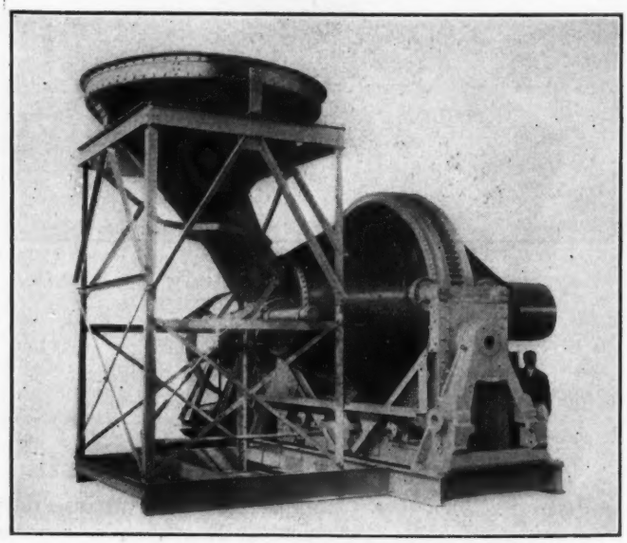


CRANE CO. FOUR-WAY VALVE

Co., of Chicago, Ill. As can be seen from the vertical section, the valve constantly regrinds to a tight seat, while there is no leak around the spring, which keeps it seated.

The Largest Concrete Mixer

The requirements of dam construction at Salisbury, N. C., undertaken by the Hardaway Contracting Co., of Washington, D. C., made necessary the use of concrete mixers larger than any that had ever been built. Consequently two machines of 4 cu.yd. (108 cu.ft.) capacity were constructed by the T. L. Smith Co., of Milwaukee, Wis. The contract requires the pouring of 60,000 cu.yd.



THE LARGEST CONCRETE MIXER

of concrete a month until completion—a total of about 1,000,000 cu.yd.—and machines of small capacity as commonly utilized would not perform the work satisfactorily.

These mixers are twice the size of any used on the Panama Canal work. They are entirely of steel, each weighing 46,000 lb. The inside diameter of the drum ring is 9 ft. 6 in. The illustration shows the comparative size of each appliance.

Company Reports

Shattuck Arizona

For 1915 the Shattuck Arizona Copper Co., Bisbee, Ariz., reports a production of 11,154,211 lb. copper, 3,151 oz. gold, 201,869 oz. silver, and 2,345,342 lb. lead. The following table gives ore tonnages:

	Copper Ore, Dry Tons	Lead Ore, Dry Tons
Ore stoped	90,481	7,500
Development ore	4,526	637
Second-class ore	563	21
Total mined	95,570	8,238
Total shipped	94,041	8,199
Total smelted	94,591	7,800

Pounds recovered per ton copper, 117.92; lead, 300.67.

The value of gold and silver per dry ton of copper ore was $1.73 and per ton of refined copper, $29.35. Lead-ore credit per ton of refined copper was $17.80. The net cost of copper after credits was 8.446c. per lb. The average price received for copper was 17.312c. per lb. on 8,622,358 lb. Unsold refined copper on hand amounted to 2,209 lb., compared with 604,747 at the end of 1914. All of the 1915 production except 18,670 lb. has been sold. The company expects to produce 1,500,000 lb. of copper per month during the high prices.

Total receipts were $2,368,547 from sale of ores and miscellaneous sources; expenditures were $1,194,520, leaving a net operating balance of $1,174,027. Construction and equipment account was increased $23,902, and $31,364 in depreciation was charged off surplus account. Dividends during the year aggregated $875,000. Balance of quick assets over liabilities was $1,309,464, or about $3.70 per share of capital stock.

It is stated that the physical condition of the mine is good and that new ore zones are being developed. An ore lens more than 400 ft. long, with an average width of 12 ft., carrying 6% copper, has been opened on the Southwest claim. It is estimated that this orebody should produce as much ore as was shipped in 1915.

Vindicator Consolidated

The Vindicator Consolidated Gold Mining Co. for 1915 reports a profit of $1,265,862 from mine operations, and $1,350,164 including miscellaneous receipts. Of this profit $1,046,939 was paid out for additional equipment, property purchases, etc., leaving a net balance of $303,225 over expenditures. Dividends amounting to $225,000 were paid, and the cash balance at the end of the year was $286,494. The total output of crude ore, 218,487 tons, produced 125,397 tons of shipping ore, averaging $23.73 gold per ton. The total assay value of the ore shipped was $2,979,851, and freight and treatment charges were $5.70 per ton, or $715,465. Of the ore produced, lessees produced 49,188 tons, averaging $16.57 per ton. The net proceeds from lease production totaled $251,624.

In March, 1915, the company purchased the property of the Golden Cycle Mining Co., comprising 43.5 acres, for $1,300,000, of which $50,000 was paid in cash and the balance was covered by 36 notes payable monthly; 35 of these notes were for $35,000 each, and the final one was for $25,000. All notes could be taken up at option of the purchaser, and at the end of the year $910,000 of these had been paid off. Of this amount $650,000 was from the earnings of the Golden Cycle mine. The company now holds 130 acres of claims.

The new Vindicator concentrating mill, which handles the reject from sorting at the orehouse, was brought up to 250 tons a day during the year. The ratio of concentration is 11 to 1, and on an average grade of $2 ore the recovery has averaged about 55%. The cost of milling is 26c. per ton. There is a large low-grade dump on the property, averaging about $2 per ton and estimated to contain about 2,000,000 tons. Metallurgical engineers have been making experiments on these ores and are now working a flotation unit of 10 tons' capacity. These experiments have led them to recommend the remodeling of the concentrator at the Golden Cycle shaft into a flotation unit of 300 tons' daily capacity. It is stated that the cost of this change will not be great and that an extraction of 90% of the gold contents at a cost of less than $1 a ton is expected to be realized.

Moctezuma Copper

Notwithstanding that the train service between Nacozari, Son., and Douglas, Ariz., was interrupted during the greater part of 1915, a net production of 22,889,885 lb. of copper is reported by the Moctezuma Copper Co., and some important improvements have been planned.

The Pilares shaft has now reached a depth of 1,285 ft., and General Manager J. S. Williams, Jr., in the annual report, states that it has been decided to do no further work in the present shaft, but to sink a new one in order to relieve for extraction a large block of ore in the immediate vicinity of the shaft, from the surface to the 1,200 level. A drift has been started on the 1,200 level to the proposed site of the new shaft, with the idea of churn or diamond-drilling the ground for another 1,000 ft. in depth before final location of the new shaft, as it is desired to keep this shaft in the barren hanging wall.

As the depth of both the Pilares and Esperanza shaft is now beyond the safe working capacity of the present hoisting engines, orders were placed for two direct-driven electric hoists, each to have a capacity of 10 tons from a depth of 2,500 ft. These are to be delivered in the latter part of 1916. The installation of this large hoist at the Esperanza will require the erection of a new steel headframe.

The concentrator at Nacozari was shut down 135 days owing to the activities of warring Mexican factions along the line of the Nacozari R.R. At three different times it became necessary to pile concentrates on the ground. In 1915, 424,027 tons of ore assaying 3.412% Cu were milled, with a recovery of 83.6% of the copper in 90,014 tons of concentrates assaying 13.316% Cu. The ratio of concentration was 4.71. The quantity of fresh

water used per ton milled was 861 gal. Four additional Dorr tanks, 10x30 ft., were installed to relieve a previous installation, which was overloaded. Experimental work was carried on with various types of flotation machines, and it was proved possible to obtain a good mineral froth without the use of acid. Plans are being prepared for a 600-ton flotation plant to treat the vanner tailings and slimes. A small precipitation plant was erected at the Porvenir tunnel to treat the mine waters, a 5 to 8% copper precipitate being obtained.

Owing to the shortage of men and the disturbed conditions of the country, it was impossible to do regular development work, and only 40% of the ore extracted was developed during the year. The total recoverable ore is estimated at 3,219,972 tons at the end of 1915.

At Churunibabi no work was done, the plans for the proposed cyanide mill being held up on account of the unsettled political condition of the country.

Burro Mountain Copper

The development and construction campaign of the Burro Mountain Copper Co. is nearing completion. Superintendent E. M. Sawyer, in his annual report, states that the first 500-ton section of the concentrator should be ready for service about Mar. 1, 1916, and construction work designed to facilitate ore extraction in the mine was also about completed. The central power station of 2,000-hp. capacity has been finished and tested. Two 1,000-hp. Diesel engines are installed in this plant, and these are to be augmented in the near future by a third of the same design, made by the Nordberg Manufacturing Co. The townsite at Tyrone, N. M., is rapidly assuming the appearance of a model town, with hospital and other semipublic buildings carefully grouped and planned under the direction of a New York architect, and about 21,000 ft. of new roads were finished last year.

Churn-drill prospecting was continued through 1915, carrying out the general scheme for testing the large northeastern group of mining claims by a series of holes placed at wide intervals. Three machines were in use, and 20 holes, having an average depth of 1,031 ft., were drilled. The general results of this work merely showed the far-reaching extent of the ore-bearing formations, but one hole was drilled through 67 ft. of ore averaging 2.67% copper. During the year 1,354,377 lb. of copper was produced from various sources, 524,200 lb. being credited to leasers.

The test mill has been partly dismantled, as it has served its purpose in indicating the proper treatment in the 1,000-ton plant. A total of 11,008 tons of ore of various types was tested in this mill. In March the work of the mill was concluded, after testing a small unit of the Rork flotation machine, the results being practically the same as those obtained with the Towne machine under similar conditions. Shipments were made to Douglas of about 3,000 tons of slime tailings for the purpose of testing by leaching methods.

As the policy of the company was to prepare the mine for ore extraction, extensive mine-repair work was necessary and general development work was subordinated. The ore reserve, however, of Dec. 31, 1915, was equivalent to 130,000,000 lb. of copper, contained in 2,555,000 tons of ore of 2.53% grade. Duplicate steel headframes and hoisting engines have been installed at No. 2 and No. 3 shafts, and concrete shaft collars placed. The Niagara tunnel for ore transportation has been completed and a 350-ton ore bin constructed above the haulage road, to serve as storage and for loading the 30-ton cars that will be used. The tunnel is 8 ft. 8 in. in width at the cap by 8 ft. 10 in. clear height above the rail.

Magma Copper

The Magma Copper Co., Superior, Ariz., reports an operating profit of $670,886 for 1915 and a net profit of $611,729 after charging off $59,157 for depreciation. The receipts from the sale of metals were $1,023,675, and the cost of production was $353,128. Balance of quick assets amounted to $442,445 exclusive of mine and mill supplies on hand. Dividends No. 1 and No. 2 were paid, amounting to $240,000. The copper production was 6,046,459 lb., and after crediting gold and silver, the average cost was 6.82c. per lb. The average selling price was 17.91c. per lb. The following table gives details of ore production and ore reserves:

ORE PRODUCTION

	Tons	Copper	Silver	Gold
Mined	46,691	6.43%	7.45 oz.	....
From dump	12,528	4.62%	5.00 oz.	....
Total treated	59,219	6.05%	6.93 oz.	....
Crude sorted	3,756	18.44%	20.09 oz.	$1.58
Mill heads	55,463	5.21%	6.04 oz.	....
Concentrates produced	15,039	16.67%	19.05 oz.	$2.18
Carbonate ore	900	8.20%	4.55 oz.	$1.20

ORE RESERVES

	Tons	Copper	Silver	Gold
Reasonably assured sulphide ore	87,000	6.72%	6.8 oz.	0.03 oz.
Ore in third-class dumps	3,000	4.85%	5.48 oz.	0.02 oz.
Total	90,000	6.55%	6.75 oz.	0.029 oz.
	Tons	Zinc	Lead	Silver
Lead-zinc ore, probable	10,000	14.0%	4.0%	10.0 oz.

No carbonate ore is included in the reserve. The company owns 346 acres of mining claims and 133 acres of mill sites.

The recovery at the mill was 86.765% of the mill feed, and 89.324% of the copper contents of the mine run of ore was treated by hand sorting and milling. The property is equipped with a 200-ton mill and an oil-flotation plant. It has a three-compartment shaft to the 1,200-ft. level and an electric hoist capable of working to 2,200 ft. in depth.

Winona Copper

The Winona Copper Co., Winona, Mich., report shows a gain of $112,194 in balance of assets, exclusive of assessments received. The output of the mine is now running at the rate of about 200,000 lb. of fine copper per month. Rebuilding the King Philip No. 1 shafthouse, which was destroyed by fire, will be completed about May and will enable the output to be increased approximately 35%.

The average price received for 1915 copper was 17.4c. per lb. The mill treated 102,594 tons of rock, from which it produced 3,032,045 lb. of mineral that yielded 1,722,638 lb. of refined copper. The recovery of mineral per ton stamped was 29.55 lb. and of refined copper, 16.79 lb. The expenses for mining, milling, transportation, etc., at the mine were $278,490; with smelting, selling, insurance, etc., the total cost was $297,807. The company ended the year with a balance of $223,324 in quick assets on hand.

Utah Copper Co.

The annual report of the Utah Copper Co., operating in Bingham Cañon, Utah, gives the following interesting data for the year 1915.

The net operating profit amounted to $15,023,834; miscellaneous income received during the year from outside investments, including dividends received from the Nevada Consolidated Copper Co. and the Bingham and Garfield Railway Co. and from interest, rentals, etc., amounted to $2,896,609. The total income therefore amounted to $17,920,443. Interest paid during the year amounted to $6,962, leaving a net profit applicable to dividends or for other capital purposes of $17,913,481, or $11.03 per share as compared with $5.34 per share for 1914. Dividends paid during the year amounted to $4.25 per share—75c. for the first quarter, $1 for the second quarter, $1 for the third quarter and $1.50 for the fourth quarter—aggregating $6,904,082, leaving surplus earnings for the year, after payment of dividends of $11,009,398. The usual amount for depreciation of plants and equipment, being a sum equal to 5% on the total cost, was set aside and amounted to $546,733. This resulted in passing $10,462,665 to earned surplus account. The total dividends up to and including 1915 are $32,721,897.

The entire net earnings of the Bingham & Garfield Railway Co. accrue to the company and properly apply in reducing the cost of producing copper.

On Dec. 31, 1915, the outstanding capital stock of the company was 1,624,490 shares.

The investments held by the company comprise 4,093 shares, Garfield Water Co.; Advances to Garfield Water Co.; 1,405 shares, Garfield Improvement Co.; 1,000,500 shares, Nevada Consolidated Copper Co.; 414 shares, Utah & Salt Lake Canal Co.; 1,000 shares, North Jordan Canal Co.; 60,000 shares, Bingham & Garfield Railway Co.; Water Rights Utah & Salt Lake Canal Co. These have a face value $510,751 in excess of book value, owing mostly to the Nevada Consolidated holdings.

Operations at the Mines

The total area of mining and other lands held by the company is 6,662 acres.

During the year, one churn-drill hole was deepened and three additional holes were drilled, the total amount of this work being 1,365 ft. The combined measurement of the 87 holes drilled from the beginning of the development of the property is 47,756 ft., or 9.05 mi., corresponding to an average depth per hole of 549 ft. The cost of all underground and churn-drill development for the year was charged against operations.

At the close of 1914 the total ore-bearing area was reckoned at 226.3 acres, and no attempt was made to add to this during 1915. However, the development work incident to operations increased the calculated average thickness of developed and partially developed ore from 465 ft. to 480 ft. Revised ore-reserve calculations show that at the end of the year there had been developed in the property 390,000,000 tons of ore, averaging 1.447% copper. Of this quantity 270,000,000 tons is classed as fully developed, and 120,000,000 tons as partly so. There was mined from the entire property prior to Jan. 1, 1916, a total of 43,684,700 tons of ore averaging 1.453% copper, and therefore the total reserves remaining amount to 346,315,300 tons, averaging 1.446% copper. In making the calculations to determine the averages, there were used 65,643 assays, representing 358,803 lin.ft. of development work. The increase of ore reserves for the year was 3,815,300 tons in excess of the tonnage mined. Much additional ore can and will be developed at opportune times when the work can be done without interfering with other operations.

The total amount of capping removed during the year was 5,961,367 cu.yd., being an average of 1,490,342 cu. yd. per quarter and an average of 496,780 cu.yd. per month, as compared with an average of 1,427,209 cu.yd. and 475,736 cu.yd. respectively for the previous year. The total amount of capping removed prior to Jan. 1, 1916, was 33,795,410 cu.yd., of which quantity 21,194,751 cu.yd. were from the Utah group and 12,600,659 cu.yd. from the Boston group. At the close of the year the total area upon which stripping operations had been conducted was 203.24 acres, and the actual area completely stripped was estimated at 96.80 acres.

With the exception of a comparatively small amount of development work in the Boston mine, no underground mining operations were conducted during 1915, and therefore practically all the ore produced was mined by steam shovels. The average cost of mining was 24.41c. per ton, of which 7.5c. represents charges for stripping and 0.3c. charges for development, leaving an actual working cost, including the proper proportionment of all fixed and general charges, of 16.61c. per ton as compared with 22.62c. per ton for the year 1914. This very notable reduction was due partly to increased output, partly to an improvement in the working conditions on the various steam-shovel levels and partly to increased efficiency in all departments.

Operations at the Mills

During the year there were milled at the Magna plant 5,233,300 tons of ore, an increase of 771,839 tons over 1914; while at the Arthur plant, which was not operated until Jan. 25, 3,261,000 tons were milled, an increase of 1,252,295 tons as compared with 1914. The total ore treated at both plants was 8,494,300 tons, as compared with 6,470,166 tons for the previous year. The Magna plant treated an average of 14,388 tons daily during the year, and the Arthur plant an average of 9,563 tons daily during the time it was actually operated.

The average grade of ore milled at both plants was slightly under 1.434% copper, as compared with about 1.425% copper for 1914. The average recovery at both plants was 64.13%, corresponding to 18.39 lb. of copper per ton, as compared to 66.04%, or 18.82 lb. per ton, for the previous year. The low extraction was due partly to the presence in the ore of considerable copper in the form of carbonates, but principally to crowding the mills for high production beyond the point of metallurgical efficiency. For the last six months of the year the average daily tonnage milled was 26,537, or about 33% above normal capacity.

The cost of milling at Magna was 30.91c. per ton and at Arthur 39.02c., as compared with 34.35c. and 37.55c. respectively for 1914. The average cost of milling at both plants was 34.02c. per ton, as compared with 35.36c. for the previous year.

The total gross production of copper contained in concentrates was 156,207,376 lb., and the average grade of the concentrates was 19.17%, as compared with 121,779,-

401 lb. and 18.19% copper respectively for the previous year.

The average cost per net pound of copper produced for the year, after making allowances for smelter deductions and crediting the value of the gold and silver recovered, but without considering miscellaneous income, was 7.56c., as compared with 8.131c. for the previous year. If total net earnings of the Bingham & Garfield Railway Co., together with miscellaneous income in Utah, were credited to the cost of production, the cost per pound would be 6.612c. These costs include all expenses of smelting, transportation, refining and selling. The net value of the gold and silver recovered amounted to 0.620c. per lb., as compared with 0.757c. for 1914. All operating costs for 1915 were less than those of previous years.

Operations of Bingham & Garfield Railway Co.

During the year the railway handled a total of 7,074,272 tons of freight, being an average of 19,382 tons daily, as compared with 5,902,196 tons and 16,170 tons respectively for 1914. Of this quantity 6,101,237 tons was ore, 5,812,723 tons having been shipped by the Utah Copper Co., and 288,514 tons by other mining companies in Bingham. The remaining 973,035 tons consisted of commercial freight, as compared with 1,072,319 tons of such freight shipped during the previous year. The total number of passengers handled was 97,304. This business was affected adversely by the curtailment of operations during the early part of the year and by the competition of motor-bus services. The average cost of transportation charged to ore was $0.2781 per ton.

General Remarks

About two-thirds of the capping on the westerly side of Bingham Cañon has been removed. In this part of the ore deposit there yet remains, according to present calculations, over 276,000,000 tons of ore. On the lower steam-shovel levels, stripping has progressed to such an extent that the quantity of capping to be removed from these during 1916 will be only about one-half that moved during 1915. On the levels near the top of the mountain, where the capping was very thick, there is still a large quantity remaining, and it is on this account desirable to continue stripping operations for a time at approximately the same rate as for the past year. It is not likely therefore that any material decrease in these operations will occur until after the close of 1916.

Throughout most of the year, considerable investigative work was done with a view of determining how best to permanently increase the capacity and at the same time the efficiency of the mills, and it is expected that active construction in this direction can be intelligently undertaken during the year 1916. The directors have authorized the construction of a leaching plant to treat the oxidized capping which has been, and is being, removed from the orebodies. It is the intention to build this plant with an initial capacity of from 2,000 to 3,000 tons per day, the arrangement being such that this capacity can be readily increased if an increase is warranted by the experience gained in the operation of the first installation. Construction on this plant will be commenced as early in the summer of 1916 as weather conditions and preparation of designs will permit. For the purpose of furnishing acid for this plant and supplying other local and some commercial requirements, the company has undertaken to participate equally with the Garfield Smelting Co. in financing the construction and operation of an acid works near the smeltery.

During the year a modification of concentrate smelting and refining contracts was secured, which resulted in an immediate decrease in the costs of those operations, amounting to about one-fifth cent per pound of copper.

Nevada Consolidated Copper

The annual report for 1915 of the Nevada Consolidated Copper Co., Ely, Nev., states that the total profits from all operations were the largest by far that have been obtained for any one year since the beginning of operations.

During the year $456,399 was spent in additions to the Steptoe plant, and $5,000 for property. The depreciation charged out plus a small amount of fire insurance collected amounted to $534,649, leaving a net decrease in plant account of only $39,597. The expenditures for construction, while apparently large in amount, are fully justified by the economies effected in production and to some extent are in anticipation of requirements later on. The same rate per ton of ore extracted for ore extinguishment in 1914 is being continued and is sufficient to fully provide for the entire amortization of this asset.

The net profit for the year available for dividends amounted to $5,905,601, or $2.95 a share; of this $1.50 a share, or $2,999,185, was paid in dividends, $347,486, or 17c. a share, was used for ore extinguishment and depreciation, and $2,558,929, or $1.28 a share, was added to earned surplus. The December dividend payment brings total dividend disbursements up to $17,976,436, and there remains in earned surplus account $4,849,555. In addition to the dividends from earnings, $1,999,457 has been returned to stockholders from surplus account, making the total payment to stockholders to Dec. 31, 1915, $19,975,893.

From the beginning of operations to Dec. 31, 1915, there have been sold by the company 391,593,615 lb. of copper at an average price of 14.128c. per lb.; total realized value, $55,324,810.

Prospecting and Ore Reserves

Work with churn drills was continued during the year on the Ruth, Eureka, Liberty and Hecla groups. On the Ruth group were drilled 17 holes, totaling 9,092 ft., and in the pit areas 23 holes, totaling 8,687 ft., or a total for both localities of 40 holes, aggregating 17,779 ft. The total as of present date amounts to 381 holes with a footage of 124,316 ft.

Considerable tonnage has been added to the ore reserves, which, as was the case in the preceding year, was greater than the amount extracted by mining operations during the year. The increased tonnage is due to new ore of good grade developed in the Ruth mine, some increased tonnage in the Eureka, and to including certain low-grade tonnage which previously had not been considered of payable grade, but which improved costs in mining, milling and smelting have shown to belong in the category of payable ore. The total of recoverable ore remaining Dec. 31, 1915, was 50,525,289 tons averaging 1.652% copper.

The figured estimate of average grade of ore is 1.652%, but it has seemed wise tc cut this down to 1.54% cop-

per, which is a reduction of 10% on underground ore and 5% on ore mined by steam shovels, the reason being that it is found that the average percentage of copper in ore mined is lower than called for by the assay plans, partly due to mining lower-grade ore not at first contemplated; partly to intermixture of low-grade capping and wall-rock; and partly to the tendency of sampling to give higher rather than lower results.

Mining Operations and Costs

During the year active mining operations were started in the Ruth mine by the caving system, and since June, 86,029 dry tons of ore have been shipped to the concentrator, averaging 2.28% copper. No mining during the year was carried on in the Veteran. Steam-shovel operations were carried on in the Eureka, Hecla and Liberty pits. The major portion of the ore was taken from the Liberty and Hecla. Owing to the favorable financial conditions and the increased demand for copper, the ore production was greatly increased during the year 1915, the tonnage mined being 16.73% more than in the previous year.

Siliceous carbonate ore amounting to 26,258 dry tons and averaging 3.48% copper, was crushed and delivered to the smeltery. All of this, with the exception of 1,083 wet tons mined in the pit during the year, was taken from the storage piles at the mine.

The number of cubic yards of capping removed for the year was 9.41% less than in the previous year, and stripping is now well ahead of requirements. The yardage removed during the year from the Eureka orebody was 108,646 cu.yd.; Liberty-Hecla, 2,649,704 cu.yd.; total, 2,758,350 cu.yd.

The total yardage removed to Dec. 31, 1915, is 17,675,637; the remaining stripping to be done lies mainly in the grade slopes. The amount of stripping annually from now on should be greatly reduced, though the reduced expenditures for this will be partly offset by expenditures required for thoroughly opening up the Ruth mine.

The direct mining cost by steam shovel for the Eureka, Hecla and Liberty pits was 15.24c. This shows a very slight increase over the year 1914, which was 15.17c. This figure includes charges of all kinds, such as labor, supplies, repairs, management, taxes, and a proper proportion of New York and Nevada overhead charges. Tax charges alone, including Federal, property and bullion taxes, all charged against mining, amounted to about 0.2c. per lb. of copper produced, or 4c. per ton of ore mined.

Stripping costs show a reduction compared with those of 1914, being for the year 1915, 28.87c. per cu.yd. as against 31.71c. for the year 1914.

Cost of mining carbonate ore was 46.1c. per wet ton, as against 62.9c. per wet ton in the year 1914.

Milling and Smelting

In addition to the treatment of the Nevada Consolidated ores, a considerable tonnage of custom ore from the mines of the Consolidated Coppermines Co., amounting to 91,732 dry tons, was handled. As was the case during the year 1914, this was mined with the Nevada Consolidated Copper Co.'s steam shovels and concentrated and smelted at the company's plant.

The ratio of concentration was a little more favorable, being 6.05 in 1914 and 7.18 in the year 1915.

The tonnages treated, assay of ore, percentage saved and ratio of concentration are as follows:

Tons of ore treated (dry)	3,081,520
Average copper assay	1.54%
Percentage of extraction (copper)	70.18%
Ratio of concentration	7.18
Assay value, gold (oz.)	0.017
Assay value, silver (oz.)	0.042
Percentage of extraction, gold	49.47%
Percentage of extraction, silver	51.34%
Average copper in concentrates	7.77%
Average gold and silver recovered per ton, in cents	18.56

The average percentage of copper contained in the concentrates was 6.145% in 1914 and 7.77% in 1915.

No new roasting furnaces were erected, but some slight improvements were made in the old ones. The operating costs were slightly higher, but the tons of concentrates calcined per furnace day were 86 in 1915 and 76 in 1914 with a slight increase in fuel ratio.

In the reverberatory department there were also improvements made in operation and a very considerable reduction in costs per ton of material treated. The cost per ton of charge smelted was the lowest obtained since the beginning of operations. The total charge smelted was 573,873 tons, and 348,377 of this consisted of calcines.

The number of pounds of fine copper in the blister produced for the fiscal year was 64,305,866, of which 1,785,011 lb., was from custom ore.

The costs per ton of blister copper produced, for 1915 were $9.76, a great improvement over those for 1914 and the lowest obtained since the converters were blown in. The grade of matte, 27.2%, was considerably lower than that for any other year since operations began, the highest being 44.6% for the year 1910.

The yield for the year 1915 of sulphide ore mined and treated and from siliceous carbonate ore delivered to the smelter was 62,726,651 lb. of fine copper. The average cost per pound of copper was 8.67c., and deducting miscellaneous earnings this is reduced to 8.23c. These costs include all possible charges, such as shipping, refining, marketing, legal expenses, taxes, New York and Nevada expenses, and also plant and equipment depreciation charges, which amount to 0.78c. per lb.; deducting the latter leaves a net cost of 7.45c. per lb. for electrolytic copper f.o.b. Atlantic seaboard.

Quincy Mining Company

The Quincy Mining Co., Hancock, Mich., reports a production of 22,054,813 lb. of refined copper for 1915, at a cost of about 9.6c. per lb. The total receipts were $3,999,745, made up of $3,972,129 from the sale of copper, $11,829 from silver production, $14,737 from interest receipts and $1,550 from the sale of real estate. The expenses were: Mining, $1,615,875; opening mine expense, $195,636; taxes in Michigan, $80,512; smelting, transportation, etc., $186,629; construction at mine, $25,382; accident account, $22,036; total, $2,126,070. The profit from operations was $1,873,674, which, added to the balance of $897,532 at the end of 1914, made a reserve of $2,771,206. From this reserve $880,000 in dividends was paid and $226,250 was paid to the Hancock Consolidated Mining Co. for mineral lands purchased, leaving a balance of quick assets amounting to $1,644,956. To the end of December, 1915, the Quincy paid 110 dividends aggregating $21,777,500. The sales of copper were made at prices ranging from 13.5c. to 22.5c. per lb. and averaged 18c.

The mine produced 1,269,000 tons of copper rock, which, according to the production stated, yielded about 17.5 lb. of refined copper per ton. It is stated that air blasts have been more or less numerous during the year, but that the necessary repairs caused by their damage have not been on a large scale. More attention has been paid to building rock-rib packs at the top and bottom of stopes, above and below each level, and these have curtailed the extension and effect of these blasts. Owing to the increased profits for the year, more money was spent on betterments of surface plant; in connection with this work 142 dwelling houses and nine mine buildings, including three shaft-rockhouses, were overhauled and painted. Other extensive repairs at the mine and mill were either completed or are under way.

Chino Copper Co.

The 1915 annual report of the Chino Copper Co., New Mexico, gives the following interesting data. The net operating profit amounted to $6,688,729; miscellaneous income received during the year from outside investments, rentals, etc., $229,073; total income, $6,917,802. Deducting interest paid during the year amounting to $3,818 leaves a net profit applicable to dividends or for other capital purposes of $6,913,983 or $7.95 per share as compared with $3.70 per share for the year 1914. Dividends paid during the year amounted to $3 per share—50c. for the first quarter, 75c. each for the second and third quarters, and $1 for the fourth quarter—aggregating $2,609,860, leaving surplus earnings for the year after the payment of dividends of $4,304,123. There was set aside for depreciation of plant and equipment an amount equaling 5% of the total cost, this depreciation charge amounting to $257,265. This resulted in passing $4,046,858 to earned surplus account. Dividends paid up to and including 1915 totaled $6,697,995.

On Dec. 31, 1915, the outstanding capital stock of the company amounted to 869,980 shares.

Mining Development and Ore Reserves

During the year there were six additional mining claims located, covering desirable ground and making a total of 153 mining claims comprising 2,734 acres. In addition the company owns 160 acres of agricultural land adjacent to the group of mining claims. The total area owned and controlled by the company in connection with its mill location at Hurley, and its various water rights and tailings-disposal system, contains 18,568 acres.

In June, 1915, churn drilling was resumed in a small way in order to determine the westerly limits of the Northwest orebody, so that the steam shovel at work in this section could carry the stripping out to the proper limits. Drilling was continued through the remainder of the year in this and other sections, also in doing some other scouting work that was necessary in advance of or in connection with stripping. The total drilling for the year was 6,909 ft. Since the beginning of operations there has been a total of 214,142 ft. drilled.

Developments for the year resulted in an increase of positive and indicated ore fully equivalent to the quantity mined, leaving practically unchanged the ore-reserve figures of the last annual report—90,000,000 tons of an average grade of 1.75% copper. Drilling will be continued, as holes indicate extensions of importance.

No extensive improvements were made or are necessary at the mines. The total amount of ore and waste moved by steam shovels during the year was 4,480,025 cu.yd. of material in place. Of this amount 3,133,916 cu.yd. was stripping, the remainder being equivalent to 2,600,271 tons of ore. Of the ore that was moved, 2,375,733 tons was shipped to the mill; the remainder, some of which was of low grade and all highly oxidized, was stored on the ore dumps for future treatment.

From the beginning of steam-shovel operations on Sept. 23, 1910, there has been moved a total of 17,494,441 cu.yd. of material in place, of which 13,322,162 cu.yd. was stripping, the remainder being equivalent to 8,370,627 tons of ore. Of this ore 944,833 tons has been stored in the stockpiles at the mine. Of the remainder 7,406,389 tons was shipped to the mill, the balance having been shipped direct to the smeltery.

The following costs, covering the mining operations, include a proper apportionment of general charges of all kinds, and for the amount of material moved, both ore and stripping for the year 1915, were 35.28c. per cu.yd. in place. This is a decrease of 1.24c. per yard as compared with the previous year. The cost of handling waste alone was 34.28c., an increase of 0.81c. over the cost for 1914. The cost of mining ore was 19.47c. per ton, or 2.66c. less than for the year 1914. This decreased cost of handling ore was due to the benefit received from the installation of the primary crushing plant at the mines, which was finished and put in operation in 1914. These better costs were made in the face of the decreased production during the first four months of the year and of an increase in wages for the last six months of the year.

Mill Operations

For the first four months of the year there was an average of 4,812 tons of ore treated per day. For the last eight months there was an average of 7,357 tons treated per day, an increase of over 53% as compared with the first four months. For the 12 months the mill averaged 6,520 tons per day, or 1,304 tons per day for each of the five sections. The total of ore treated for the 12 months amounted to 2,379,800 tons, this being the largest quantity treated in a year since the beginning of operations. The average running time, while in commission, of all sections for the year was 92.98% of the possible time. The large increase in the amount of ore treated during the last eight months was made possible by the completion of the installation of additional power and by the changes made in the mill and in concentrating methods. The best previous record was for the first seven months of 1914, when an average of 1,345 tons per actual section-day was made, while for the last eight months of 1915 the mill averaged 1,573 tons per section per day, or an increase in capacity equivalent to practically 17%.

The average content of the ore treated for the year was 2.155% copper. The total production of concentrates was 158,444 tons, corresponding to a ratio of concentration of 15.02 tons of ore to produce one ton of concentrates. The total amount of copper contained in concentrates was 68,293,893 lb., corresponding to an average concentrate grade of 21.551% copper and a recovery of 28.697 lb. of copper per ton of ore, representing an extraction of 66.588% of the copper content. The ratio of concentration and the grade of concentrates were higher than for the previous year, as a result of the im-

provement in the concentrate-recleaning plants that were in service throughout the year.

The average milling cost for the year was 54.19c. per ton, a decrease of 0.82c. from that of the previous year, and the lowest cost for any full running year since the plant started. This reduced cost resulted from the increased tonnage that it was possible to treat.

Average Cost of Copper

The average cost of net copper produced from concentrates, after making deductions for smelter allowances and crediting gold values, was 7.12c. per lb., as compared with 7.6c. per lb. for the previous year. The gold credit amounted to 3.35c. per ton of crude ore treated, or 0.12c. per lb of copper produced. The per-pound cost as stated includes operating expenses and charges of every nature except depreciation. If miscellaneous earnings for the year were credited to the cost of producing copper, the net cost of all copper, based as stated, would be 6.75c. per lb., as against 7.35c. per lb. on the same basis for the previous year.

Extensions and betterments in the mill and its operation are progressing satisfactorily. The improvements being applied will not only raise recoveries, but will result in a substantial increase in production.

Butte & Superior Copper Co.

The fourth annual report of the Butte & Superior Copper Co., Ltd., puts the operating profit for 1915 at $9,074,151, which, with additional miscellaneous income of $51,795, makes a total net income of $9,125,947, as compared with $1,417,127 for the year 1914. This is equivalent to $33.47 per share, there being 272,697 shares outstanding at the close of the year.

The production for the last quarter was the largest in the company's history, every effort being made to produce as large an output as possible, so as to take full advantage of the existing demand and high prices.

During the year dividends to the amount of $4,908,115 were paid, made up of four quarterly disbursements of 75c. per share and extra dividends of $15 per share.

After providing for dividends, additions to properties and other capital expenditures, there was an increase in the working capital for the year of $3,502,514.

Development and Ore Reserves

The principal item of development undertaken during the year was that of sinking the main shaft to the 1,900-ft. level in preparation for opening up the Black Rock orebodies on the 1,700 and 1,800 levels and developing the 1,600 level for active mining. The shaft has been completed to a depth of 1,920 ft., which is the limit to which this shaft will be used. The 1,600-ft. level has been developed for a length of about 700 ft., and the orebodies disclosed both east and west of the shaft are fully as large as on any of the levels above, and they are also of substantially the same grade and character. Extensions of orebodies were developed to the eastward on all of the working levels, from the 1,000 to the 1,500, considerably beyond points where commercial orebodies were previously known to exist, thus disclosing in this direction important additions to known ore-bearing areas.

Aside from the items mentioned, only incidental development work was undertaken during the year for the sole purpose of opening up additional orebodies, but nevertheless the developed ore reserves at the end of the year were approximately the same as at the beginning of it, or about 1,000,000 tons—a quantity fully as great as good mining practice justifies blocking out ahead of extraction in these orebodies.

The total ore mined for the year was 522,949 tons. The average cost of mining was $3.36 per ton including all expenses for development work directly connected with mining and blocking out ore reserves, but exclusive of exploration work on outlying claims.

Mill Improvement and Operation

The principal item of mill improvement was that of rebuilding the flotation department for the double purpose of improving its efficiency and enlarging its capacity. The constant increase of tonnage treated made it necessary to correspondingly extend many features of mill equipment, this being more particularly true as to fine-grinding and slime-settling apparatus. During the year the capacity of the plant as operated was approximately 60% greater than for the year 1914, this increase having been brought about without extensive additions to any element of mill equipment or to mill buildings. Notwithstanding this, both recoveries and grade of concentrates were materially improved. The total ore milled during the year was 522,300 tons, the average rate for the last quarter having been about 50,000 tons per month, corresponding to 600,000 tons per annum. The ore milled contained an average of 17.02% zinc and 7.63 oz. silver. Both of these figures are slightly lower than the average for the previous year, the decrease being due principally to the fact that higher prices of zinc and lower costs of milling made it possible to profitably treat lower-grade ores. Mill recoveries average 92.21%, or about 3.5% more than for the previous year. For the last quarter of the year the average recovery was 95.07%. The average milling cost was $1.75 per ton, as compared with $2.12 for the previous year.

Production and Costs

Of the 522,300 tons of ore milled for the year the average and total contents of each metal were:

	Oz. Gold	Oz. Silver	Lb. Cu	Lb. Pb	Lb. Zn
Total contents	7,361.517	3,985,090.18	2,215.313	12,667,964	177,802,719
Average assay	0.01409	7.6299	0.2121%	1.2127%	17.0211%

The total production of zinc concentrates was 152,897 tons, which contained the following averages and totals of metal:

	Oz. Gold	Oz. Silver	Lb. Cu	Lb. Pb	Lb. Zn
Total contents	6,163.677	3,385,164.19	1,751,545	7,485,489	163,956,791
Average assay	0.0403	22.140	0.573%	2.448%	53.616%

The production of lead concentrates amounted to 5,274 tons, and the average assay value and content of metals in these were as follows:

	Oz. Gold	Oz. Silver	Lb. Cu	Lb. Pb	Lb. Zn
Total contents	286.034	178,218.38	40,665	3,988,679	1,426,130
Average assay	0.0542	33.792	0.386%	37.815%	13.520%

The total gross value of lead and zinc concentrates as sold to smelters was $13,244,133. The average total cost of actual mining and milling for the year was $5.11 per ton, this figure including all general charges and mine-development costs as well as the cost of mainte-

nance and all minor improvements in both mine and mill. These operating costs were lower than those for 1914, notwithstanding labor costs were higher on account of the sliding-scale wage schedule based on metal prices that averaged much higher than for the previous year and the further fact that additional expense was involved in crowding production really beyond the point of efficiency as to capacity of mining and hoisting facilities.

The main shaft will be provided with a direct-connected electric hoist suitable for operation to a depth of 3,500 ft. and convertible without material delay or great expense to a capacity suitable for operations to a depth of 5,000 ft. The manway shaft will also be provided with an electric hoist designed for operations to a depth of 5,000 ft. These two shafts are located 60 ft. apart in solid ground well away from the orebodies and therefore as nearly as practicable free from the hazard of ground movement due to mining operations. It is expected that this entire equipment will be completed and in use to the depth of present mining operations about the end of the year 1916. The mill does not require any extensive alterations but preparation is being made for a number of minor improvements looking to still higher recoveries and more economical handling of both ores and concentrates.

Ray Consolidated Copper Co.

The annual report of the Ray Consolidated Copper Co., Ray, Ariz., states that the year 1915 was the most prosperous period in the company's history. At the close of the year the output was sold farther ahead than ever before. Dividends at the rate of 37½c. per share quarterly were resumed in the second quarter of the year, and this rate was increased to 50c. in the fourth quarter. There were outstanding at the close of business on Dec. 31, 1915, 1,571,279 shares of capital stock. The year's operations resulted in an increase of net current assets of $2,084,856.88.

Miscellaneous income was $376,691; total income $4,750,062.

Mine Development and Ore Reserves

During the year no development work was done for the direct purpose of proving additional ore reserves, but a total of 45,292 ft. of underground work was driven in the conduct of active mining operations in areas tributary to the three shafts. This is 29,969 ft. less than for the previous year. There will be some increase in development during the coming year, as the work of opening up the third level at shafts Nos. 1 and 2 will be prosecuted vigorously. On completion, this level, in conjunction with the two main levels already developed, will serve all the ore tributary to the two main shafts. When this work is finished, there will be no further expenditures for main haulageways, and development will then consist of the less expensive work directly incident to mining operations. The total development since the beginning of operations and up to the end of the year 1915 is 497,525 ft., or approximately 100 mi., of which mining operations have destroyed 224,698 ft., or about 45 mi. During the year 2,854,314 tons of ore was mined, leaving of the originally developed and reported orebody, 71,911,475 tons averaging 2.235% copper. These figures are derived by difference, no actual recalculation of tonnages having been made, and it should be borne in mind that there are areas of considerable extent where the orebodies, more particularly at depth, were not drilled to their full limits. It is certain that large tonnages in excess of those heretofore or now reported will become available in the future when occasion justifies.

Mining Operations

Owing to industrial conditions in the first and second quarters and labor disturbances in the third, the fourth quarter was the only one in which the mine output was approximately normal, averaging for that period 8,633 tons per day.

The 2,854,314 tons of ore mined consisted of 2,852,577 tons of concentrating ore averaging 1.673% copper and 1,737 tons of sorted ore from the No. 3 shaft, which was shipped direct to the smeltery. In addition to the ores produced by the regular operations, 9,203 tons was mined and shipped direct to the smeltery from surface deposits. Of concentrating ore mined during the year 4% was derived from development, 6% from active stoping and 90% from reserve drawing. Mining operations in all orebodies have now progressed to a state where it is not necessary to have such a large reserve of broken ore as formerly, and this now amounts to about 3,000,000 tons, equivalent to a year's supply for the mill.

The net mining costs for the year show a slight decrease over those for the previous year. The average cost of mining for the year was 62.68c. per ton as compared with 62.42c. for 1914. This cost included the fixed and general charges as well as the cost of operating the coarse-crushing plants at the mine and the loading of the crushed ore in the railroad cars for shipment to the mill. The latter costs amount to 3.71c. per ton, leaving the net cost of mining 58.97c. per ton as compared with 59.32c. for 1914.

The higher-grade orebody tributary to the No. 3 shaft is of such shape and location that the regular mining system cannot be applied and the square-set method is used. The cost of mining by this method is approximately four times that applying to the ore produced by the regular system. Eliminating the No. 3 shaft, the cost of the ore produced at the No. 1 and No. 2 shafts, including the coarse-crushing and loading, was 58.12c. per ton.

Mill Production and Costs

The total ore milled for the year was 2,848,969 tons, corresponding to a daily average of 7,805 tons, as compared with 2,427,700 tons for 1914. The total tonnage of ore milled since the beginning of operations and to the end of 1915 was 9,889,360 tons, averaging 1.717% copper. The average grade of the ore milled for 1915 was 1.673% copper, as compared with 1.76% for 1914. The average recovery was 64.11%, corresponding to 21.45 lb. of copper, per ton as compared with 67.88%, or 23.9 lb. per ton, for the previous year. The recoveries were affected adversely during the first half of the year by irregularities in operations and even more so during the latter half by interference of construction work in mill improvements at a time when the price of copper was such that it was more profitable to treat a normal tonnage by increasing the load on sections not affected by

the construction work, even at some sacrifice in metal recoveries.

The cost of milling increased slightly for the year and was 50.86c. per ton as compared with 49.88c. for the previous year.

The production of copper contained in the concentrates was 61,114,514 lb. The average grade of concentrates for the year was 19.293%, as compared with 19.25% for 1914. In addition to the copper contained in concentrates there was produced from ores shipped direct to the smeltery 1,425,682 lb., making the gross production of copper from all sources 62,540,196 lb. The average cost per pound of net copper produced from milling ores, after making allowances for smelting and refining deductions and crediting dividends from the Ray and Gila Valley R.R. (but no other miscellaneous income), as a reduction of operating costs, was 9.478c. per lb. The combined cost per pound of net copper produced from milling ore and direct shipping ore for the year was 9.497c., as compared with 8.839c. per lb. for the previous year. These costs include all operating and general charges as well as 12½c. per ton of ore milled, which is applied to the retirement of mine-development costs. This latter charge is equal to 0.59c. per lb. of net copper produced from all sources for the year. By crediting all miscellaneous income as a reduction of costs, the per pound cost of net copper produced becomes 9.423c., as compared with 8.763c. for the previous year.

Notwithstanding the many interferences and disadvantages experienced in operation during the year and to which attention has been briefly directed, the annual output was substantially increased over that of any previous year, and there is good reason to expect that increases of production will be still more rapid within the next year. The physical condition of both the mining and milling plants is excellent, and with the completion of improvements now under way at the mill, increased capacity and production should be accompanied by lower costs.

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The Railway Freight Embargo

Freight conditions seem to be improving upon the railroads in the East, and lately the embargo committee of the Eastern Freight Accumulation Conference has materially modified the embargo, particularly on the New Haven R.R. during the past two weeks. As a result of the modifications that have been adopted by the committee, many commodities are now accepted for shipment into New England that were formerly on the excluded list.

The object of the committee has been to relieve the situation existing on the New Haven road in the first place and to permit shipments into New England of freight already held up by connecting lines in the next place, and finally to open up this territory for new freight as fast as the situation warrants. Exceptions to the embargo that are of particular interest to the mining community include such items as bleaching powder, caustic soda, soda ash, niter cake; coal for company use, hospitals, asylums, schools and public utilities; charcoal, coke, copper, spelter, zinc, pig lead, crucibles in carload, salt and foodstuffs for human consumption. The list includes a large number of other items. The American Railway Association figures a net car supply for Apr. 1 of 3,650, compared with a shortage of 20,551 on Mar. 1. It is evident that car shortage has been relieved.

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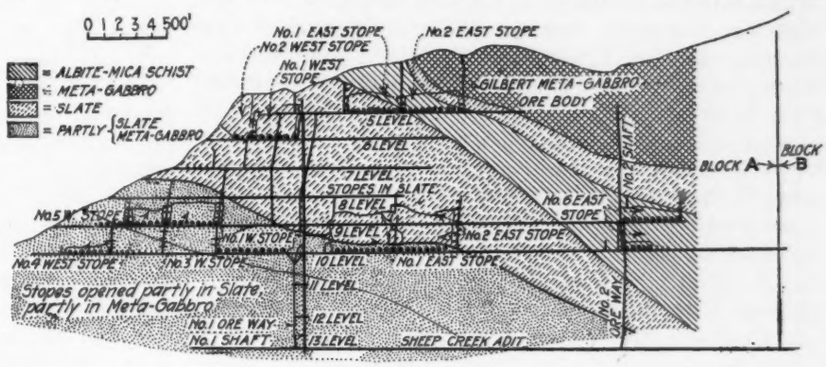
Alaska Gold Mines Co.

The fourth annual report of the Alaska Gold Mines Co., for the year 1915, gives many interesting details of a very important and satisfactory year of operations.

The year was one of particular interest in that it marked the beginning of productive operations and, barring unimportant details, the completion of construction and equipment. The mill was completed to a daily capacity of 10,000 tons and the Annex Creek power supply was fully developed and equipped.

The operating profit for the period was $251,848, being 22 581c. per ton treated. To this there should be added



SECTION OF PERSEVERANCE MINE, SHOWING GEOLOGIC FORMATIONS TRAVERSED BY THE ORE ZONE

$26,923 of miscellaneous income, making the total profit for the year $278,771.

Prior to the year 1915 a detailed plan of mine development was adopted and systematically carried out. This provided for driving of the Sheep Creek tunnel, parallel to the lode system, to develop the ore zone and at the same time afford a means of transporting the ore. It also contemplated opening up the west end of the property, known as the Perseverance block, by means of inclined foot-wall oreways 2,000 ft. apart, for the purpose of delivering the ore by gravity from the various levels to the Sheep Creek railroad situated 2,000 ft. in depth below the average surface outcrop, a vertical shaft for the purpose of transporting men and supplies throughout this section of the mine and working levels or drifts every 200 ft. in elevation from the Sheep Creek level to the surface through which to transport the broken ore from the stopes to the oreways.

The development work during the year amounting to 17,346 ft. of drifts, tunnels and raises, and 5,943 ft. of diamond-drill holes, was practically all done for the purpose of facilitating actual mining and only a part east of the shaft on Nos. 6 and 7 levels to open up new ore. For this reason the estimated available tonnage in the Perseverance block reported in the year 1914 has undergone no material change.

Both mine sampling and mill results on ore from the various stopes, as well as other investigations and analyses

of this block, show the highest-grade ore encountered occurring in the schist body as opened in the No. 2 east stope on No. 5 level, and No. 6 east on the No. 9 and No. 10 levels, this schist deposit having a strong rake to the east and consequently appearing farther away from the central shaft and workings on successively deeper levels, until on the No. 10 level it is first encountered east of the No. 2 shaft. The ore from this section has averaged both by sampling and mill results, in excess of $2 per ton, the No. 2 East on the No. 5 level averaging $2.70 per ton, but due to its remoteness from the main shaft, very little development toward preparation for actual mining was done until recently.

The slate orebody is the lowest grade so far developed and particularly so west of No. 1 shaft where the vein widens out in some places to twice and even three times the width of the original development of 70 ft. This widening of the ore zone resulted in a corresponding although not proportionate decrease in value.

East of the shaft below No. 5 level the slate orebody is narrower and higher-grade, as evidenced from the values obtained in the Nos. 1 and 2 stopes east on the Nos. 9 and 10 levels, and from the new development and sampling east on Nos. 6 and 7. The vein being narrower, the ore is more concentrated and the values range from $1.50 to $2.50 per ton, so far as developed.

West of the shaft below No. 9 and down to the Sheep Creek level, the orebody is made up of meta-gabbro and slate, the meta-gabbro dike replacing the foot wall and making up a large percentage of the total orebody. This section so far as sampled and opened is higher-grade than the slate body west of the shaft as already desribed, although lower-grade than the schist, but will furnish ore of an average grade.

Mixture Necessary for Mill-Grade Ore

It had been originally determined from sampling and analyses of the results obtained before milling operations began, that if a mixture of ore could be made, approximating 25% from the schist orebody east of the shaft, 25% from the slate orebody east of the shaft, and 50% from the slate orebody west of the shaft, ore of an average grade would be sent to the mill so long as these percentages were maintained, and actual results have proved this to be true.

However, as mining operations progressed, it was found, owing to the rake of the schist orebody, which was not thoroughly understood at the beginning of operations, that the No. 6 stope east on the No. 9 level rapidly passed out of the schist into lower-grade slate and the No. 1 stope east on the No. 5 level, lying under the schist, did not furnish a high-grade ore as expected because the underlying slate caved away and prevented any mining in the schist at all and thus furnished only low-grade material, whereas a large tonnage of high-grade ore had been counted upon from this stope and will yet be derived from the schist orebody here when it can be attacked from another direction.

This condition left but one stope available in the schist orebody, namely: No. 2 east on the No. 5 level, from which only a fixed amount of ore could be drawn each month, regardless of the total tonnage sent to the mill, on account of mining conditions prevailing until the stope was entirely finished to its ultimate height. This situation had the inevitable effect on the value of the ore sent to the mill, as increased tonnage had to be drawn from the stopes west of the shaft in the lower-grade section, and the percentage of high-grade ore as originally depended upon dropped in proportion to tonnage increase from 25%, as calculated, to 5% in November, when 6,000 tons of ore per day were sent to the mill.

As soon as this condition became apparent, new development work was started east on Nos. 6 and 7 levels for the purpose of opening out other stopes in this higher-grade section. Preparation of new stopes was also begun east on No. 10 level in this schist orebody, and west on No. 10 in the good-grade meta-gabbro and slate zones. Pending the time when these new stopes can be made ready for substantial production, it has been necessary to reduce the tonnage in order to maintain a satisfactory grade of ore.

During the year 15.6% of the ore sent to the mill was drawn from the stopes opened on the schist orebody, 56.7% was drawn from the low-grade slate zone west of the shaft and east of the shaft on No. 5 level, 23.1% was drawn from the higher-grade slate orebody east of the shaft on Nos. 9 and 10 levels, 1% from the meta-gabbro slate zone west of the shaft on the No. 10 level, and 3.4% from development.

It should be said further that of the 56.7% of the total ore coming from the low-grade sections, 25.4%, or very nearly half of this and a quarter of the total ore sent to the mill, came from the No. 3 west stope on the No. 9 level and No. 1 east on No. 5, the two lowest-grade stopes so far developed anywhere in the Perseverance block. They happened, however, to be the first stopes prepared under the regular development schedule, and were consequently the first ones ready for operation and in condition to deliver large tonnages. While it is considered advisable to discontinue mining from these areas for the time being, they will undoubtedly produce very large tonnages of profitable ore at a time when the property is operating at full capacity with the mine opened up in such a way as to insure an average grade and character of ore by drawing it from many instead of a few sections.

Power-Supply Division

At the Salmon Creek hydro-electric project a new steel transmission line, 8 mi. in length, from Salmon Creek through Juneau to the milling plant, was constructed and put in operation, thus completing this project to its maximum efficiency and capacity. The Annex Creek project is capable of a maximum development of 12,000 hp. at low cost.

The cost of power developed at Salmon Creek and Annex Creek and all other sources during the year was 0.268c. per kw.-hr., or 4.8c. per ton mined and milled. On a basis of 6,000 hp. this cost was 0.145c. per kw.-hr., or 2.6c. per ton mined and milled.

On Jan. 1, 1915, there was a total of 427,999 tons of broken ore lying in the old stopes as a result of past operations. During the year 1915 there was broken in the stopes, 1,885,100 tons, and in addition to this there was obtained from development work 39,303 tons and from the preparation of stopes, 165,217 tons, or a total of 2,089,620 tons, the total ore broken on Dec. 31, 1915, including that broken prior to Jan. 1, 1915, being 2,517,619 tons. Of this amount 1,116,825 tons were sent to

the mill, leaving a balance on hand as of Dec. 31, 1915, of 1,400,984 tons.

The cost of ore breaking during the year 1915 was 22.471c. per ton including 5.25c. per ton charged against mining to create a proper reserve to cover the cost of preparing new stopes as old ones are exhausted; the actual cost of breaking ore was therefore 17.22c. per ton, and during the month of November, when the maximum tonnage for the year was handled, the cost was 20.1c. per ton including the arbitrary charge for preparing stopes.

At the end of the year the mine had reached a balance through the completion of stopes so that during the ensuing year approximately the same amount of ore will be mined as milled. This is so because the ore broken and remaining in new stopes will be offset by ore drawn from stopes already finished.

Underground tramming from stopes to oreways, by means of storage-battery locomotives and automatic dump cars, cost for the year 4.997c. per ton. For the month of maximum tonnage the cost was one cent per ton less. The cost of transporting ore 3½ mi. from the mine to the mill was 3.641c. per ton average for the year, and the cost for the month of maximum tonnage was 2.568c. per ton.

The total average cost of ore delivered from the mine to the mill during the year, including prepaid expense and proper apportionment of all general charges, was 31.441c. During the month of November, when 6,000 tons per day was delivered to the mill, the total cost was 28.499c. per ton.

Mill Operation and Costs

During the year 1915, 1,115,294 tons of ore was milled, having an average value of $1.1569. The average tails were 21.91c., showing an extraction of 81.06%. Prior to the year 1915 there had been milled in the operations, from 1907 to 1912 inclusive, 384,445 tons, averaging $1.949 per ton gross. The total ore milled from the mine up to Dec. 31, 1915, is therefore 1,499,739 tons, having an average head of $1.3532.

While milling operations actually started during the month of February, it was not until the first of March that the first section of the mill was operating under normal conditions. A gradual increase of tonnage was made up to and including the month of November, when an average of 6,000 tons of ore per day was handled.

Throughout each department of the milling plant—that is to say, coarse-crushing, fine-grinding, concentrating and re-treatment plant—the results were equal to or better than originally obtained in experimental work. The average total milling cost for the year was 30.496c. This may be compared with the costs for November of 25.699c., when an average of 6,000 tons of ore per day was put through the mill. At larger capacity costs will be lower. The average total net cost per ton for the year of mining, milling and disposition of products and inclusive of all fixed and general charges, was 69.039c. The cost for November was 59.785c. per ton.

With the exception of the difficulty of maintaining an average grade of ore to the mill, operations have been invariably satisfactory. The methods adopted in mining, milling and the operation of the power plants are and have been entirely successful and the results equal to or better than our original estimates.

Miami Copper Co.

The Miami Copper Co., operating at Miami, Ariz., produced 17,575,879 lb. of copper in the first half of 1915 and 24,256,180 in the second half, making a total of 41,832,059 lb. derived from 1,348,122 tons of ore. The total profits were $3,408,562, or $4.56 per share, of which $2.25 was disbursed in dividends amounting in total to $1,681,004. Earned surplus was increased $3,175,346. Although the ore carried 0.11% less copper than in the previous year, the yield was 0.7 lb. of copper higher per ton of ore, for the mill extraction was raised from 69.93% to 75.17%.

Mining the Captain orebody by shrinkage stoping is under way with excellent results. Slicing of the main orebody has proved so satisfactory that the ore above the 570-ft. level is being prepared for extraction by the same method. There is no difficulty in turning out the 4,200 tons of ore per day required by the mill. A total advance of 21,746 ft. of drifts and raises was made during the year, of which 10,787 ft. were in the Captain orebody. To check up churn-drill results, there were 667 samples taken by drifting 3,388 ft. The average was 1.24% copper, against 1.21% estimated by churn-drill work. Underground costs were reduced from $1.18 in 1914 to $1.01 in 1915.

There were no additions to the ore reserves during the year. On Jan. 1, 1916, they stood as follows: High-grade sulphide ore, 18,140,000 tons at 2.40% Cu; low-grade sulphide ore, 17,000,000 tons at 1.21% Cu; 6,000,000 tons partially developed mixed sulphide and oxide ore carrying 2% Cu. Churn drilling in the low-grade sulphide area has been resumed in the hope of increasing the tonnage, 1,252 ft. of holes having been completed, but no new calculation of reserves has been made pending the results of other holes still to be drilled.

The increased recovery has already been mentioned. The grade of concentrates was raised from 39.31% to 41.91%. Iron balls have been substituted for pebbles, giving increased tonnage with a finer product than can be obtained with the pebbles. Experimental work on the recovery of the oxidized copper in the mill feed and some promising results have been obtained. Costs of milling ore up to the point of placing the concentrates on railroad cars are:

Direct crushing expense	$0.19725
Direct concentrating expense	.21402
Tailings and concentrates handling	.04740
Water for concentrating	.09721
Experimental expense	.02352
Total	$0.57940

The results of milling operations were: Ore milled, 1,348,122 tons at 2.17% Cu; concentrates produced, 52,539 tons at 41.91% Cu, or 44,033,761 lb. Cu in the concentrates. From this the smeltery returns were 41,832,059 lb., the cost of refined copper in concentrate on board cars at Miami being as follows:

	Per Ton Ore	Per Lb. Copper
Mining	$1.0158	$0.032736
Milling	.5794	.018672
General	.2833	.009130
Total	$1.8785	$0.060538

There was practically no construction except altering the mill, chiefly in the installing of additional concrete tanks and a sump for clarifying the overflow, a pumping plant of 1,500 gal. per min. capacity and a 525-hp. boiler to care for the increased amount of power required for mill operation.

The Porphyry Coppers in 1915

By Percy E. Barbour

The Miami operations for 1915 were a distinct operating achievement. The ore carried 0.11% less copper than in the previous year, but the yield was 0.7 lb. of copper higher per ton than in 1914. The mill extraction was raised from 69.93% to 75.17%, and underground costs were reduced from $1.18 to $1.01 per ton.

Miami milled the smallest tonnage of the "Big Six" low-grade producers, but milled the highest-grade ore—2.17%, compared with Chino 2.155% and Utah, the lowest, 1.434% copper. It made the highest-grade concentrates, 41.91%; Inspiration next, with 32.67%; and Nevada Consolidated lowest, 7.77%. It made next to the highest recovery—75.17%, compared with Inspiration 79.95%, Ray 64.11% and Utah 64.13%. The Nevada Consolidated is the only one of the six that smelts its own ores, which accounts for the lack of necessity of making higher-grade concentrates. The Miami mill practice differs from the Inspiration in that the former was originally a wet-concentration mill to which flotation was subsequently added, while the original plans of the Inspiration were discarded *in toto* and an oil-flotation plant substituted.

Inspiration started copper production in July and has brought its output up to 8,300,000 lb. for the month of February last. Costs and recoveries are gratifying.

The Utah Copper was, of course, preëminently the leader of the country's low-grade producers during 1915, treating more than double the tonnage of any other one.

Chino had a prosperous year with no especial changes either way in operating details.

Contrasted with these coppers is the operation for the year 1915 of the Butte & Superior Copper Co., which, by the way, produces mainly zinc and very little copper and is taking steps to strike the word "copper" from the corporate name. It is a milling proposition, however, comparable in both size and method with the others, using as it does oil flotation for concentrating.

The total ore treated was 522,949 tons; the average for the last quarter was at the rate of 600,000 tons per annum. The ore averaged 17.02% zinc and 7.63 oz. silver per ton. Mill recoveries averaged 92.21%, which was about 3.5% more than for the previous year, and for the last quarter the average recovery was 95.07%.

During the year the capacity of the plant as operated was approximately 60% greater than for the year 1914, this increase having been brought about without extensive additions to the mill equipment. Notwithstanding this intensive operation, both recoveries and grades of concentrates were materially improved. The average milling cost was reduced to $1.75 from $2.12 for the previous year. The operating costs also were lower, notwithstanding the higher labor costs on account of the sliding-scale wage schedule based on metal prices and the further fact that additional expense was involved in crowding production beyond the point of efficiency as to capacity of mining and hoisting facilities.

Here is a mining and metallurgical accomplishment where every effort was made to profit by unusually high metal markets, and not only without sacrificing a single factor of effectiveness in either the mining or metallurgical end, but with an actual increase in efficiency and a decrease in costs.

1915 Operations	Utah Copper	Chino	Ray	Nevada Con.	Miami	Inspiration
Tons of ore milled	8,494,300	2,379,800	2,848,969	3,081,520	1,348,122	778,851 (b)
Tons of ore milled per day	26,537 (h)	7,357 (f)	7,805 (n)	8,442 (k)	4,200 (m)	4,267 (e)
Average copper content of ore, %	1.434	2.155	1.673	1.54	2.17	1.702
Average copper content of concentrates, %	19.17	21.551	19.293	7.77	41.91	32.67
Ratio of concentration	.....	15.02	.....	7.18	.....	24.6
Total pounds copper produced	156,207,376	68,293,893	62,540,196 (a)	64,305,866 (i)	41,832,059	20,445,670 (c)
Pounds copper recovered per ton of ore	18.39	28.697	21.45	.....	.....	26.4 (b)
Extraction, %	64.13	66.588	64.11	70.18	75.17	79.95
Average milling cost per ton, cents	34.02	54.19 (c)	50.86	.....	.....	51.585 (d)
Average cost of copper per pound, cents	6.612 (g)	6.75 (g)	9.423	7.45	6.05 (j)	8.132
Ore reserves, tons	346,315,300	90,000,000	71,911,475	50,525,289	.....	.....
Copper tenor of ore reserves, %	1.446	1.75	2.235	1.652	.....	.....
Dividends paid	$6,904,082	$2,609,860	$1,872,319	$5,905,601	$1,681,004	.....
Added to earned surplus	$11,009,398	$4,046,858	$2,084,856	$2,558,929	$3,175,346	$600,062 (o)
Charged off for depreciation	$546,733	$257,265	$301,936	$534,649	$176,213	.....

(a) Including 1,425,682 lb. produced from ores shipped direct to smelters. (b) Six months' production. (c) Including 378,360 lb. from oxide ore shipped direct to smelter. (d) Including coarse crushing at mine. (e) Tonnage for February, 1916, averaged 12,300 per day. (f) Average for last 8 months. (g) After crediting al miscellaneous income. (h) Average for last 6 months. (i) Fine copper in blister produced; includes 1,785,011 lb. copper in custom ores. (j) F.o.b. cars, Miami; freight, marketing, etc., probably under 1.25c. per ton. (k) No allowance made for period of curtailment early in year. (l) The annual report says while a yield of more than 20 lb. per ton of ore can be obtained from much of the ore, a better mining practice can be followed and more ultimate profits obtained by mining ore producing 20 lb. on the average. (m) Nominal. (n) Average for last quarter, 8,633 tons. (o) Six months' operation.

During the time they were operated, the two mills averaged 23,951 tons of ore per day, including the curtailment early in the year, but during the last six months the average tonnage milled was 26,537, which was 33% above normal. This big increase in production naturally tended to lower mining costs, which decrease amounted to 6.01c. per ton, but as naturally tended to decrease milling efficiency, the mill recovery having been 64.13 against 66.04% the year previous. This was only 0.02% better recovery than that made by Ray, which made the lowest of any of the "Big Six" low-grade producers.

At the Nevada Consolidated the year's operations were in detail almost all more advantageous than in 1914 and the total results were the best in the company's history.

At Ray industrial conditions militated against efficiency, but the tonnage mined was slightly larger than in 1914 and the mining costs decreased slightly. Both the grade of the ore milled and the recovery were less than in the year previous, and the cost of milling increased. The mill recovery is the lowest of the big low-grade producers. The cost of copper increased over 1914.

Butte & Superior certainly carries off the palm for 1915 from the point of professional merit, and it paid $4,908,115 in dividends and added to its working capital $3,502,514 besides.

The Wah Chang Mining and Smelting Co.

K. C. Li, of the New York branch of the Wah Chang Mining and Smelting Co., started for China Apr. 13, expecting to be absent from New York for several months. Prior to his departure Mr. Li in an interview outlined what his company has done during the last year and what are its plans for the future.

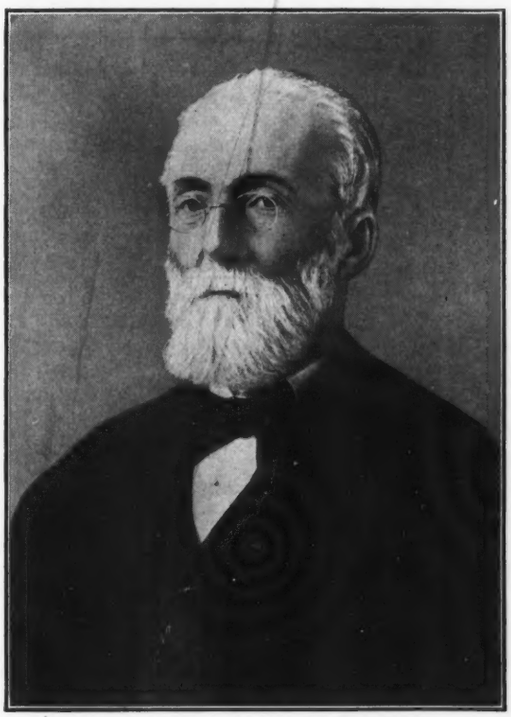
At present the Wah Chang company is selling between 700 and 800 tons of antimony per month in the United States, which is more than half of the total American

business in this metal. The company is also a smelter of tin and a producer of tungsten, lead and zinc ores. It is probable that it will soon become an exporter of tungsten and zinc ores and of pig tin and pig lead, and it is probable, moreover, that some of those products will come to the United States. The Wah Chang company is the leading mining and smelting company of China and is very enterprising.

Erasmus Darwin Leavitt

Erasmus Darwin Leavitt, whose death on Mar. 11, in his 80th year, was briefly noted in the *Journal* of Mar. 25, was for many years a mechanical engineer of high reputation. For the more extended sketch of his life and the accompanying photograph we are indebted to *Power*. He was born at Lowell, Mass., in 1836, educated in the local schools and learned the trade of machinist in the old Lowell Machine Shop. In 1858 he was assistant foreman for Harrison Loring at South Boston and had charge of the building of the engines for the famous "Hartford" of the United States Navy.

From 1859 to 1861 he was chief draftsman for Thurston, Gardner & Co., Providence, R. I., then among the



ERASMUS DARWIN LEAVITT

few builders of high-class steam engines. From there he entered the United States Navy in 1861, serving during the Civil War and until 1867, the last two years of which he was instructor in steam engineering at the Naval Academy at Annapolis. After that he engaged in practice as consulting mechanical engineer. One of his first designs was for a beam condensing engine for the Plymouth Cordage Co., built in 1869 and still in use. He also designed the engine for the first cable railroad on the Brooklyn Bridge. He was appointed consulting engineer of the Calumet & Hecla Mining Co. in 1874, which position he retained until 1904. For this company he designed a great deal of heavy machinery for pumping, general power purposes, hoisting and stamping. The largest was the engine "Superior," with cylinders 40 and 70 in. diameter, stroke 6 ft. and speed 60 r.p.m.

Mr. Leavitt was one of the 30 who organized the American Society of Mechanical Engineers in 1880 and later was president of the society. The degree of doctor of engineering was conferred upon him in 1884 by the Stevens Institute of Technology; this was the first time this institution conferred this degree. He was a member of the Institution of Mechanical Engineers of Great Britain for 33 years, and was made an honorary member last February. He also was a member of the Institution of Civil Engineers of Great Britain, the American Society of Civil Engineers, American Institute of Mining Engineers, Boston Society of Civil Engineers (honorary), American Society of Naval Engineers (honorary), British Association for the Advancement of Science (life member), the Franklin Institute and the New England Water-Works Association (honorary). He was a Fellow of the American Academy of Arts and Sciences.

Zinc Smelting in Great Britain

The London *Times* reports that an agreement has been reached between the spelter-producing companies in Great Britain and the Munitions Department on the subject of new works, with a view to increasing the production of spelter within the United Kingdom. Under the agreement the companies will be allowed, first, to deduct from their excess profits the difference between the cost of new construction during the war and before the war; and, secondly, they are to receive a reward from the Munitions Department for extending their works in the form of being allowed to deduct from their excess profits, before taxation, 50% of the pre-war cost of construction. Thus, if the cost of new works were put at £100,000, as compared with £75,000 before the war, the companies would be allowed to deduct £25,000 from their excess profits. They would further be able to deduct £37,500 from the excess profits, leaving a similar amount to be found out of profits not liable to taxation or in new capital.

Since the war spelter-producing companies have earned very large profits. As the works are controlled establishments, 80% of the excess profits would, but for this arrangement, be taken by the state. The Munitions Department guarantees the companies against the effect of any possible objections to the scheme that might be taken by the Chancellor of the Exchequer, and it also undertakes to "play the game" in allowing the companies to continue earning excess profits. Otherwise, if the Munitions Department managed to beat down the price of spelter to a very low level, the excess profits might prove a disappointing fund for meeting the cost of new construction.

On the strength of the agreement at least one company is arranging to double its smelting capacity with all possible speed. Others will probably follow suit. While the plan will enable the British smelting industry to be established on a much more satisfactory footing than hitherto, there remains for discussion in future the question of such measures as may be necessary to encourage its development.

Correspondence and Discussion

Tempering Drill Steel

The tempering of drill steel for particularly hard ground was solved here by using the following methods:

If there is any possibility of the bits having been overheated, as is invariably the case if they have been in use at all under any but a master smith's attention, cut off 4 in. and see that new bits are forged at as low a heat as is consistent with prompt work. While the bits are cooling off, make up a barrel half full of concentrated brine and then fill it up with plain water so that the temperature will be as near 70° F. as possible. Suspend a 6-in. permanent horseshoe magnet horizontally above and handy to this barrel by a cord approximately 20 in. long. Heat an old bit to something over cherry-red and hold it at that temperature so that the cutting edge is within ⅛ in. of the poles of the magnet and wait for the heat to fall to that point at which the magnet will be attracted. Practice this several times until the eye is accustomed to the color that just barely precedes that next lower shade at which the magnet is attracted. Now get just as short a heat on your new bits as you can—something between ⅜ and ⅝ in. (1 in. is too much)—and turn the bit steadily to insure that it is perfectly even. Endeavor to get it out of the fire and into the barrel (of half-saturated brine) in the shortest possible time, so that the heat at plunging is only a mere trifle above that at which the magnetic property returns. If the heat is rather too high when taken from the fire, wait for it to drop to the proper temperature; if it is decidedly too high, put it one side to cool off slowly. The bits that are caught just right have run from 14 to 20 in. on the average here and occasional ones have done 23 to 24 in., while one bit cut 36 in.

As to just what this difference in tempering has meant here, in drilling an extremely hard silicified schist resembling quartzite as regards hardness, let me say that the average duty obtained from the best brands of steel in the past was more nearly 8 in. than anything over that figure and there was constant trouble due to loss of gage, corners pulling off, etc. We now use only 4 gages for drilling 54-in. holes, starting with 2½-in. and finishing with 1½-in. bits and can drill the distance every time in 40 min. without any binding of drills or flaking off from cutting edges, which are the usual results of faulty tempering.

So far as we have been able to prove the value of this magnetic test, it applies perfectly to all grades of steel, for the more carbon they contain the lower seems to be the indicated heat for plunging, while low-carbon steel demands a much higher heat. The advantages of having such a positive control and one that can be equally well applied by day or night regardless of the grade of the steel—within moderate ranges of course—will appeal to all who are interested in getting the highest duty out of drill steel.

In conclusion let me say that we are indebted to John Cassidy, master blacksmith, for all of our success in solving the question of proper tempering. I merely discovered the value of the magnetic test during his search for a practical means of insuring uniform results independent of variable conditions of light.

JOHN B. STEWART.

Howie Mining Co., Waxhaw, N. C., Apr. 12, 1916.

Electric Welding Process for Mine Repairs

There has been published a certain amount of information on the use of the oxyacetylene welding method for repair work, and even for construction work, around mines. I have seen nothing on the use of the rival process, electric welding. The latter would seem to present certain advantages, provided it will do what is claimed for it. Will it do this? Descriptions of the method are easily had, and large claims have been made for its efficiency and general suitability, but these originate in sources that cannot be considered wholly unprejudiced. I suggest that information on the actual performance of the electric process, supplied by those who have used it for mine repairs, would be of interest and value to the profession.

Gas welding requires the use of oxygen and some fuel gas. The latter is commonly acetylene, which as a rule can be easily produced on the spot, since today carbide is a standard supply. Oxygen can be had, so far as I know, in three ways, namely: Compressed and canned; manufactured from chemical compounds (chlorate of potash is chiefly used and is exceedingly high in price at present); obtained from the dissociation of water. In the last case hydrogen is also made and can be used for low-temperature work.

In the case of the remote mine, served by a mule trail, it is a nuisance and an expense to maintain a constant supply of either compressed oxygen or chlorate of potash. For dissociating water, an elaborate and expensive plant is necessary. On the other hand, cheap current is usually available at even the small and remote property. It appears feasible to apply an electric current to welding by the use of home-made apparatus, but the standard controlling set offered by the manufacturers is not extraordinarily expensive. Electric welding therefore seems to be the logical process. However, certain questions arise:

Can the process be readily picked up by the ordinary mine mechanic? Is the standard apparatus furnished reasonably foolproof? Is it a trouble and expense to maintain a stock of electrodes and fusing wire? Is the method safer or more hazardous than the oxyacetylene method? Can the equipment be sectionalized for mule-back transportation? And above all, can good welds be made on broken cast iron, since a large part of the work around mines will be the repair of iron castings?

New York, Apr. 18, 1916. L. O. KELLOGG.

Editorials

The Situation in Metals

Without any doubt copper is, from the standpoint of the producers, in a more brilliant position than ever was known before. The producers are sold far ahead, at prices ranging from 20 to 28c. per lb., and are insured a fine average for 1916, no matter what happens. Unsold stocks of refined copper in their hands are practically at the irreducible minimum, and consequently there is a large premium for immediate and near-by delivery. The immense sales recently consummated are spread over the remainder of this year, and upon the present basis of output there is relatively little unsold copper for the second half of 1916.

The development of this situation naturally led domestic manufacturers to become nervous and has recently induced them, in some cases, to contract for copper in excess of the orders for manufactured products that they have yet on their books. This is naturally a risky thing for them to do, for they are simply making a gamble on the market. However, the situation is such that some of the most conservative producers have advised their customers to do this. This should not be interpreted as indicating conditions that will create a buyers' panic. On the contrary, the production of copper is increasing steadily and largely, and especially are there being important increases in refining facilities. Consequently, as the year wears on, more and more copper, not yet contracted for, will become available, but the present outlook is that it will command a higher price than at present. Disregarding the copper for near-by delivery, which is sold only in trifling quantities and already commands a large premium, it is probable that we shall ere long see the major market in the neighborhood of 30c. per lb., perhaps higher.

The position in lead is always different from that of any of the other important metals, for the reason that a very large part of the production goes into consumption on the basis of average-price contracts. So large a part of the domestic consumption being thus taken care of, the effects of a special demand for the surplus, or vice versa, a pressure to sell it, is always magnified. This was illustrated recently when an exceptional demand developed from Russia and Japan and resulted in raising the outside market to 8c. both in New York and St. Louis. The largest producer, recognizing the ephemeral character of this and desiring to maintain the equilibrium between domestic production and consumption upon a sound basis, refused to advance its price to the figures prevailing in the outside market, although if it had been demonstrated that the new conditions were going to be otherwise than temporary, eventually it would doubtless have been forced to do so. Its diagnosis of the situation is apparently proving to be correct, speculative excesses were restrained, and judging from the present look of things, the boom in lead has culminated for the present at least.

In the case of none of the important metals have commercial conditions been so utterly disrupted as with spelter. This follows from a variety of factors—the narrow margin of stocks with which the business is conducted, the ease with which new concerns can enter the business, the riotous competition among producers, the contractual relations between miners and smelters, and especially the great discrimination among different kinds of spelter that has been produced by military buying. When spelter rose to previously unknown heights, about a year ago, the common prophecy of the experts was that a collapse would come soon and that spelter would probably be down to 6@8c. per lb. by the end of 1915, the reason being the great increase in production that was being stimulated. Up to the present time the prophets have been proved wrong, but the future will show that they were wrong only with respect to their estimate of time.

The statistics of this industry are the handwriting on the wall. The production of spelter in the fourth quarter of 1915 was 50% larger than in the first quarter. There is no other of the great metal industries in which such a thing could be achieved. It could not be done in iron, or in copper, or in lead. The production of spelter is still increasing at an enormous rate. Perhaps the only restraining factor is the shortage of ocean-carrying capacity, which makes it troublesome to bring hither ore from foreign countries, but up to the present time shippers and importers have succeeded in worrying along with that situation. It is only a question of time when the increasing production of spelter is going to exceed the demand for it and is going to break the market. This is manifestly the reason why producers are so anxious to sell far ahead and are willing to make such great differences in price in order to do so. Within recent weeks we have witnessed spelter sold in large quantities for the second quarter of 1916 and the second half of 1916 at a difference of 4c. per lb. in the price. The fact that no such condition exists in the cases of either iron, or copper, or lead, is in itself sufficient food for reflection.

The Position of the Copper Companies

The official reports of the copper-producing companies for 1915 have now been published by nearly all of them, the Anaconda and the Calumet & Hecla being the chief exceptions. These reports show uniformly large productions, enormous profits and the possession at the end of the year of huge surpluses. These profits and these surpluses were accumulated on the basis of a selling price for copper of about 17¼c. per lb., that being the quotational average. What the companies actually realized on the average is uncertain, for most of them have been reporting their gross prices, and the difference between gross and net prices in 1915 was extraordinarily large, and moreover there are some other confusing conditions and practices. It is probable that the startling results of 1915 were achieved on a basis of something less than 17¼c. per lb. for copper.

We dwell upon this point simply to elucidate that remarkable as was the position of the copper-producing companies at the end of 1915, it must have been far more so at the end of the first quarter of 1916, for during the last three months there has been not only a huge production of copper, but also the deliveries have been huge and the price realized on them has ranged from 20 to 27c. per lb. Moreover, these companies have sold so much of their expected output during the remainder of 1916 that they are insured an average price for this year that will be higher—and probably a good deal higher—than that of 1915.

The copper-producing companies of the United States now find themselves in a financial position far stronger than they were ever in before. No longer do they have to borrow money to finance their copper between mine and market, and over and above the surplus that they need for properly carrying on their business they possess large reserves of cash, or cash equivalent, that may be paid out to their stockholders in the form of immediate dividends or may be preserved to insure the maintenance of their present dividends for many years to come, no matter what may happen to the copper market; or they may use it for extension of their business, or they may do a mixture of all of those things. Some concerns will pursue one policy, some another, but whatever may be determined upon by anyone, the public will do well to recognize that the standard copper-mining companies have attained a position of practically assured stability.

The Recent Copper Sales

In December last everybody engaged in the copper-producing industry was startled by the news that the British government had bought 60,000 long tons—about 135,000,000 lb.—of copper in one contract at about 20c. per lb. Never before had there been known such a colossal transaction in copper. Recently that was far surpassed, however, when France and England jointly contracted in a series of transactions for about 300,000,000 lb. of copper, and another European government took about 100,000,000 lb., all at about 27c. per lb. Yet, save in the copper market itself, these transactions excited scarcely more than a ripple of interest.

About a year ago the speculative public was all agog with the war orders—for shrapnel, shells, rifles, etc.—that were being placed in this country. Wall Street was aflame with reports of the enormous profits that the Bethlehem Steel Co., the Crucible Steel Co. and the powder, arms and ammunition companies generally were going to make. Over all hung the veil of mystery, which no doubt was the very thing that was exciting. Some of those companies have probably realized the enormous profits that were estimated. In the cases of the Du Pont powder company and the Bethlehem Steel Co. there is no doubt about it. In other cases there has been disappointment. We were extraordinarily astonished to learn a few weeks ago that up to that time not a single rifle had been delivered under the orders of 1915 and that there had been great delay and trouble in the filling of those orders.

But here in the copper business we had lately some real war orders about which there was no mystery. The companies receiving them did not make any official statements respecting them, but it was not difficult to learn in the trade with regard to both quantity and price. This business fell to a group of industrial companies, which have for many years been in the habit of making very full reports respecting their operations. Let us say that their average cost of producing copper is about 10c. per lb. In selling 400,000,000 lb. at 27c. they may safely count upon a profit of $68,000,000, which will be divided among relatively few concerns. But Wall Street took no notice of this. Indeed, copper stocks declined.

The recent business leads to a train of thought. Why do England and France require so much copper? How does Germany manage to get along with a much less quantity? That Germany does in fact get along with less is scarcely to be doubted, for her own production is but a trifle and she now imports it from nowhere. Assuming that she has been tearing down her structures, it is hardly to be imagined that she is getting so much copper as the Allies are using. Is there some connection between this and preparedness? When the war is over, one of the most interesting and important revelations will be the explanation of this.

The Armor-Plate Nonsense

Apparently the bill for the creation of a Government armor-plate plant is going to be passed by Congress. It will then become a law, for it is an administration measure. There will be no cost-keeping in the new plant, by order of Congress. It would not do to let the taxpayers know that armor plate made by the Government may cost more than for what private concerns offered to supply it.

The upshot of the matter will be therefore that the Government will spend $11,000,000 for a duplication of existing plant. This is simply throwing away money. On the other hand, the plan for a Government nitrogen plant, which would not duplicate anything, does not seem to be meeting with favor.

When Congress undertakes to do its own engineering, it usually makes a mess of things. In the present case it is making a mess of things in a scandalous way.

What Next in Mexico?

The American troops chasing Villa penetrated as far south as Parral, were attacked there by a Mexican mob, defended themselves and retired in order to avoid further hostilities. Villa not having been caught, nor likely to be, the Parral incident caused a great deal of excitement both in Mexico and Washington, and Carranza having intimated that it was time to talk of American withdrawal, Washington began to talk of it.

So the end will probably be that we shall retire from Mexico just as we did from Vera Cruz, and the bandits will have free hand again provided they keep away from the American border. Here was a chance to intervene in Mexico for the restoration of order there with the united backing of the American people, but it is not to be—yet.

The increase of 10% in wages promised by the Steel Corporation for May 1, which will undoubtedly be followed by the chief independent concerns—and necessarily by all the others—will bring wages in the steel trade up to the highest point on record.

BY THE WAY

Several years ago a new checker was employed in the shipping department at the Raritan Copper Works, says the *Ingot*, and upon being told to go out on the farm and check the pigs, he replied: "Nothing doing. I've heard too much about sky-hooks to be caught on any stuff like that!"

⁂

The sensitiveness of the human eye and its ability to distinguish color were made the subject of an interesting experiment by Professor Nichols, of Cornell University, says the *American Machinist*. Ninety-two different shades of blue were placed before 54 observers, and the general average for placing these shades in proper relation was over 95%.

⁂

A tired Easterner going into Arizona banishment, riding in the lonely passenger car on a mixed train, was much disturbed by the occasional bellowing of the conductor concerning some sage-brush station. Finally the pestiferous conductor sang out the name of a station in an unusually grating key. The t. E. looked out to see only a box-car station, turned a withering glance on the conductor and said, "Bring it in."

⁂

We noticed the following advertisement in a Milwaukee paper and found it so exciting that we are glad to republish it without charge, just as a matter of interest:

THE LOST PLATINUM MINE

of Northwestern Wisconsin Discovered. Also Gold, Silver and other Metals; exceedingly rich, laying idle for want of capital.

We will Lease or Sell. There is untold millions in this discovery. Seeing is believing. Come and inspect the same. One day is all that is required for one that understands h!s business.

I made this discovery in 1898 and there has been a freeze-out ever since.

Advice to those that are interested. You must understand your business or have a private chemist. There will be parties on hand to betray, deceive, or laugh you to scorn. But seeing is believing, come.

For further information call personally on me at the following address,

Knute Thompson, or better known as
WISCONSIN KNUTE, THE PROSPECTOR,
Route 5, Box 6, Manomonie, Wisconsin.

We wish we could feel sure that Wisconsin Knute knows what he is talking about, but as he says that one day is enough for one who understands his business to find out, there is a sporting chance. The chief trouble would be in finding somebody who understands his business.

⁂

Resourcefulness and ingenuity have been shown by New England manufacturers in their efforts to overcome the difficulties in the way of securing an adequate supply of steel because of the embargoes against freight shipments into New England, says the New York *Sun*. One Connecticut company has chartered barges and is floating the much needed supply of wire rods from the Trenton plant of the American Steel and Wire Co. down the canal and Raritan River and up the Sound to the works. Another Connecticut manufacturer, after securing steel by boat in the same way, is trucking the metal 30 to 40 mi. overland. One New England manufacturer of war munitions, requiring a constant exchange of supplies between the Bethlehem Steel Co. and the New England plant, has established an automobile line between the two points, with a relay in New York City. Another illustration of the stress under which manufacturers are working is the chartering of a freight car at a passenger-coach rate by a manufacturer in New Jersey. The freight car, which contained hinges—essential to the continuance of work at the factory—was sidetracked at a New England point. The railroad refused to carry the car until the manufacturer offered to pay passenger rates. The car was then attached to a regular passenger train.

⁂

The palm for being the highest-priced industrial must be awarded to the Union Sulphur Co., bids for which stock have advanced to $9,000 a share with none offered. The company, a close corporation, has outstanding but $200,000 capital stock, 2,000 shares of $100 par value. The Union Sulphur Co. has long been regarded as the world's largest producer of sulphur. Its position has been materially strengthened since the outbreak of the war through curtailment of other production, notably from pyrites formerly imported in large quantities from the Rio Tinto copper mines in Spain. Increased demand for sulphur brought on by the war has resulted in an advance in price from $22 per ton to $28.50 per ton. Not only does the company have the unique distinction of being the highest-priced stock in the country, but it also has the highest dividend rate, as for the past seven or eight years returns to stockholders have amounted to 100% monthly, or $1,200 per share per year. The company's property in Louisiana is believed to operate at a profit of $17 per ton, which on a year's output of 400,000 tons would amount to $6,800,000. This would be equal to $3,400 per share. During the past few months since attempts were first made to secure stock of the Union Sulphur Co. the bid price has advanced from $4,400 per share to $9,000 without bringing a single share upon the market, says the *Boston News Bureau*.

⁂

The following verses exhibit a model spirit for all interested onlookers and innocent bystanders. They were written by Emma Jarvis, a high-school girl at Sutter Creek, Calif., and recited at the town's celebration of the reopening of the old mine after thirty years of idleness.

THE OLD EUREKA

The daylight hours were fading fast
When through a mining village passed
The rumor startling, strange and bold,
That Hetty Green at last had sold
Eureka!

Oh! news to fire the miner's zeal,
The Eureka sold for woe or weal!
At last to search for yellow gold
Through stopes and levels of the Old
Eureka.

How hoary grandsires love to tell
To wide-eyed youngsters, listening well,
Of high-grade ore, of wealth untold
Concealed in caverns of the Old
Eureka.

Some pessimists of course there be,
"There never was and ne'er will be
Enough good rock, enough fine gold
To pay for exploiting the Old
Eureka."

Ah well! be rumor false or true,
It matters not to me or you;
But if it's true that it is sold,
Good luck to those who bought the Old
Eureka!

PERSONALS

James E. Dick, lately in Denver, is now at Whitefish, Colorado.

Philip Maverick has removed from Anaconda, Mont., to Globe, Arizona.

P. W. George, recently at Hollywood, Wash., is now at Wallace, Idaho.

M. F. Ward, formerly at Denver, Colo., is now at Barranquilla, Colombia.

Roy H. Clarke has removed from Spokane, Wash., to Takilma, Josephine County, Oregon.

T. R. Hunt, lately with the Syndicate Mining Co. at Aroroy, Masbate, Philippine Islands, is now in Denver.

C. D. Stark, Jr., recently at Newport, R. I., is now at the Plumas Eureka mine, Johnsville, Plumas County, California.

Wallace E. Pratt has resigned his position with the Mines Department of the Philippine Islands to enter into private practice.

W. H. Plummer, formerly at the Holman mine, has succeeded Frederick Eckman as superintendent of the Arcturus mine on the Mesabi iron range.

Andrew W. Newberry is now with the Exploration Department of the Goldfield Consolidated Mines Co., with headquarters at 805 Crocker Building, San Francisco.

J. Parke Channing, C. R. Corning and Charles F. Rand, of New York, are taking a vacation together in Cuba and will return to New York about the end of April.

Chester W. Washburne, formerly with the U. S. Geological Survey, has returned to the United States from the Belgian Congo when he has been for two years prospecting for oil.

W. E. Malm, of the Malm Wolf Co., Denver, Colo., has completed the examination of mining properties in the Moses mining district in Washington, and has returned to Denver.

D. G. Kerr, vice-president of the United States Steel Corporation, and McGilvary Shiras, ore agent for the corporation, both of Pittsburgh, have been looking over the Oliver Iron Mining Co.'s mines in the Lake Superior district, in company with Oliver officials.

A. C. Brown has been elected general manager of the Brown Hoisting Machinery Co., Cleveland, Ohio, succeeding R. B. Sheridan, who has resigned to accept a position with the American International Corporation, New York City. Mr. Brown is also vice-president of the company, and has been assistant manager.

M. H. Merriss has resigned his position on the metallurgical staff of the Baltimore plant of the American Smelting and Refining Co. to become superintendent of the electrolytic refinery and silver department at the Raritan Refinery of the Anaconda Copper Co. in Perth Amboy. His address is Box 22, Perth Amboy, N. J.

Andrew Christensen, formerly chief of the Alaskan Field Division of the General Land office, has been appointed manager of the Land and Industrial Department, which has just been established under the Alaskan Engineering Commission. He will have his headquarters at Seward, Alaska, and will report directly to the Commission. He will have charge of all matters relating to the public lands tributary to the Government railroad.

OBITUARY

Barnett F. Shearer died at Laurium, Mich., Apr. 5, aged 62 years. He was born in Michigan and was employed in the iron mines around Ironwood for a number of years. About 25 years ago he was appointed superintendent of the Wolverine mill at Gay, and later of the Mohawk mill. About a year ago he was put in charge at the new White Pine Extension.

William B. Anderson died at Leadville, Colo., Mar. 26, aged 50 years. He was born in New York, but had lived in Colorado nearly 30 years. For a number of years he operated the Hope mine near Leadville. Some years ago he started the project of driving a tunnel through Prospect Mountain for the purpose of prospecting and opening ore deposits believed to exist there.

John P. K. Miller died at Scottdale, Penn., Apr. 8, aged 59 years. He was born in Martinsburg, W. Va., and went to Pittsburgh when a young man. About 30 years ago he became chief engineer for the McClure Coke Co., and when that company was merged with th H. C. Frick Coke Co. he was made chief engineer for the consolidated company, retaining that position until his death. He was a member of the American Institute of Mining Engineers and of the North of England Mining Institute.

Edgar D. Huntley died Apr. 9 in San Antonio, Tex., where he had gone in hopes of benefiting his health. He was 55 years old, and was born in Wisconsin. When 18 years old, he went to Dakota Territory and soon after removed to the Black Hills, later entering the employ of the Homestake Mining Co. He rose to the position of assistant foreman of the mine, which he held for nearly 30 years and upon the death of W. S. O'Brien, he was appointed general foreman. He resigned in December last on account of continued ill health.

SOCIETIES

Lehigh University—During the month of April the senior miners and geologists in charge of Dr. B. L. Miller of the Department of Geology, and Prof. Howard Eckfeldt of the Mining Engineering Department, made their annual inspection trips to several of the more interesting mining centers of the East. Cornwall, Penn., was visited on Apr. 1. Mt. Hope, N. J., was visited on Apr. 8. Franklin Furnace, N. J., was the attraction Apr. 14 and 15.

University of Utah—In the metallurgical department of the State School of Mines, there have been established five research fellowships of the value of $720 a year each, which are open to college graduates who have had some training in chemistry and metallurgy. Applications for them will be received for this year, up to May 15. Those holding fellowships for the fiscal year 1915-1916 and the fields in which they are working are Glenn A. Allen, University of Kansas, flotation processes; Richard W. Johnson, University of North Dakota, hydrometallurgy of zinc; Harper C. Neeld, Nevada University, hydrometallurgy of zinc; Clarence E. Sims, University of Illinois, electrolytic processes; M. J. Udy, University of Utah, hydrometallurgy of lead; Harry J. Morgan, Leland Stanford Jr. University, cyanidation; George F. Stott, University of Utah, losses in milling processes.

Joseph A. Holmes Safety Association—The following is a list of the various associations which have joined in the movement to establish a memorial to the late Dr. Joseph A. Holmes, with their respective representatives: American Institute of Mining Engineers, Hennen Jennings; American Mining Congress, Dr. David T. Day; American Federation of Labor, A. E. Holder; Mining and Metallurgical Society, Dr. George Otis Smith; American Society of Mechanical Engineers, General W. H. Bixby; American Institute of Electrical Engineers, John H. Finney; American Electro-Chemical Society, Dr. F. G. Cottrel; American Association for the Advancement of Science, Dr. L. O. Howard; American Chemical Society, S. S. Voorhees; Geological Society of America, Dr. Joseph Hyde Pratt; National Academy of Sciences, Dr. David White; American Red Cross Society, Dr. Robert U. Patterson; Western Federation of Miners, Joseph D. Cannon; Mine Inspectors' Institute, J. W. Paul; Society for the Promotion of Engineering Education, Professor O. P. Hood; United Mine Workers of America, William Green; National Safety Council, H. M. Wilson; American Forestry Association, P. Risdale; American Society of Testing Materials, A. W. Gibbs. At a recent meeting in Washington a permanent organization was effected under the name of the Joseph A. Holmes Safety Association and the following officers were elected: President, Van H. Manning; vice-presidents, Charles D. Walcott, Samuel D. Gompers; members executive committee, Hennen Jennings, Dr. John A. Brashear. The present functions of the association were formulated as follows:

1. That annually the association shall make one or more awards with honorariums to be known as "The Holmes Award" for the encouragement of those originating, developing and installing the most efficient safety devices, appliances or methods, in the mining, quarrying, metallurgical and mineral industries during the previous year, these awards to be the results of reports and investigations made by the secretary and the representatives of the association.

2. From time to time the association shall also make suitable awards for personal heroism or distinguished service or the saving of life in any branch of the mining, quarrying, metallurgical and mineral industries.

3. Once a year a meeting of the association shall be held in the city of Washington at which all awards will be publicly announced.

TRADE CATALOGS

Knox Motors Associates, Springfield, Mass., Folder, Hauling Costs Reduced. Illus.

Link-Belt Co., Chicago, Ill. Booklet No. 238, Grab Buckets. Illustrated, 12 pp., 3½x6 in.

The Wm. Powell Co., Cincinnati, Ohio. Booklet, White Star Gate Valve. Illustrated 20 pp. 3½x6½ in.

Vanadium-Alloys Steel Co., Pittsburgh, Penn. Folders. Vasco Nonshrinkable and Vasco Choice Tool Steel

American Roller Bearing Co., Pittsburgh, Penn. Bulletin No. 1003. Roller Bearings. Illustrated, 6½x10 in.

The Jeffrey Mfg. Co., Columbus, Ohio. Bulletin No. 171, Manganese Steel Chains. Illustrated, 20 pp., 6x9 in.

Manitowoc Engineering Works, Manitowoc, Wis. Folder, Saving of Production Cost The Surest Profit. Illus.

National Tube Co., Pittsburgh, Penn. Bulletin No. 26, Autogenous Welding of National Pipe. Illustrated, 52 pp., 8½x11 in.

Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Bulletin No. 1417A. Smelting Furnaces and Accessory Equipment. Illustrated, 48 pp., 8x10½ in.

National Safety Council, Continental & Commercial Bank Building, Chicago, Ill. Bulletin, Weekly Safety Bulletin. Illustrated, 76 pp., 11x8½ in.

The Under-Feed Stoker Co. of America, Harris Trust Bldg., Chicago, Ill. Catalog, Jones Under-feed Mechanical Stoker. Illustrated, 32 pp., 6½x10 in.

Armco Iron Culvert and Flume Manufacturers Association, Middletown, Ohio. Catalog. Armco Iron Flumes, Lennon Type. Illustrated, 38 pp., 6x9 in.

Nordberg Manufacturing Co., Milwaukee, Wis. Bulletin No. 27A. The Nordberg High Compression Two-Cycle Oil Engine. Illustrated, 16 pp., 8x10½ in.

The Yuba Construction Co., San Francisco, Calif. The Yuba Bulletin. Vol. 1, No. 3. Illustrated, 16 pp., 10x7 in.

These bulletins are published quarterly for the benefit of customers.

John A. Roebling's Sons Co., Trenton, N. J. Catalog Roebling Wire Rope. Vol. I, No. 2, illustrated, 16 pp. 6½x9½ in. Copies of this catalog will be mailed regularly, free of charge to any wire rope user interested.

C. H. Wheeler Mfg. Co., Philadelphia, Penn. Condensing Equipment. Illustrated, 178 pp. 6x9 in.

Besides the chapters devoted to the usual condensing apparatus are two unusual chapters on cooling towers and spray cooling systems. Catalog on heavy plate paper, very well illustrated and contains tables pertaining to condensing problems.

"Waterproof Graphite Grease" is the title of a new 16-page booklet by the Joseph Dixon Crucible Co., Jersey City, N. J. This little book deals with the care and up-keep of heavy, slow-moving machinery and parts that are exposed to unusual wear, such as lubrication of plungers, the best way to handle wire rope, open gearing and dredging machinery. A copy will be sent to anyone interested.

The Redwood Manufacturers Co., San Francisco, is distributing its catalog No. 7, descriptive of Remco redwood pipe, which it manufactures. The catalog has an unusual amount of valuable data pertaining to wooden pipe, wooden tanks, and the flow of water under various conditions. Not the least interesting part of the catalog is comprised in two pages giving specific directions on how to set up wooden stave tanks.

The Deming Co., Salem, Ohio, is distributing its Catalog 25 describing the Deming pump for hand and power purposes. The book contains 358 pages of heavy plate paper well illustrated, and handsomely bound in gray buckram. Beside the usual catalog features regarding the pumps which the company manufactures, the book contains valuable technical data and engineering tables applicable to pumping problems.

The Ohio Brass Co., Mansfield, Ohio, is distributing its catalog No. 16, covering overhead materials, rail bronze, car-equipment specialties and high-tension porcelain insulating material, and all equipment for electric railways, mine-haulage systems and power transmission lines. The catalog is bound in green buckram and contains 654 pages. It is admirably gotten up, well illustrated, and contains some valuable tables regarding copper wires, etc.

The American Sheet and Tinplate Co, Pittsburgh, Penn,. is distributing a paper published in the "Journal of Industrial and Engineering Chemistry" (American Chemical Society), March, 1916, entitled "Research on the Corrosion Resistance of Copper Steel," by B. M. Buck, metallurgical engineer, American Sheet and Tinplate Co., and J. O. Handy, director of laboratories of Pittsburgh Testing Laboratory, Pittsburgh, Penn. A synopsis of the results of the research are: Copper increases the resistance of steel and iron to atmospheric corrosion; its influence is apparent when the copper content reaches 0.03%; its effect is almost at a maximum when the copper reaches 0.05%; the best amount of copper for commercial steel has been set at 0.25%; steel containing 0.25% copper outlasts pure iron containing 0.05%; steel containing 0.05% copper lasts as long as pure iron containing 0.05% copper. The influence of copper is probably due to its control of the sulphur; sulphur in steel accelerates corrosion very markedly; sulphur oxides in the air accelerate the corrosion of steel; copper in steel counteracts or retards both corroding influences.

Copies of this pamphlet will be mailed on request.

INDUSTRIAL NEWS

Harry Channon has been chosen president and James A. Delaney vice-president of the MacMaster Carr Supply Co., of 174 No. Market St., Chicago.

The Great Western Smelting and Refining Co. has opened an office in New York in the Woolworth Building under the management of H. S. Green.

The Goodyear Tire and Rubber Co., Akron, Ohio, recently shipped a conveyor belt so large as to require delivery in four sections. The total weight was over 23 tons.

The Morgan Engineering Co., Alliance, Ohio, has purchased the plant of the Canton Steel Foundry, Canton, Ohio, which is a well-equipped steel company, and will make an important addition to the Morgan plant.

E. S. Cullen has retired from his position as a representative of the Niles-Bement-Pond Co. and has formed the E. S. Cullen Machinery Co., dealer in tools and equipment in the Leader-News Building, Cleveland, Ohio.

The offices of the U. S. Smelting Co., the U. S. Metals Refining Co., the Cia de Real del Monte y Pachuca and the U. S. Smelting, Refining and Mining Co. have been removed to the Equitable Building, 120 Broadway, New York.

The Chicago Pneumatic Tool Co. recently made an express shipment weighing 13,000 lb., consisting of one air compressor and four Hummer hammer drills to the International Trading Co., New York. The machines are to be reshipped to South America to be used in construction of water-works in Uruguay.

The annual reports of 80 industrial companies which have become available for 1915 show average earnings on their stocks of 20.36%, comparing with 9.63% in the preceding twelve months. This remarkable showing represents the revival of activity of domestic business and the huge war orders placed here by the Allies.

The National Tube Co. has published a bulletin of 50 pages on the oxyacetylene welding of National pipe, showing that it is more advantageous to make pipe joints by welding than it is with the ordinary fittings. This bulletin is an exhaustive treatment of the subject and is one that ought to be studied carefully by miners, mill men and smelters.

The Gibb Instrument Co., of Pittsburgh, Penn., is introducing a neat and compact optical pyrometer for the observation of high temperatures in metallurgical furnaces. The principle of the instrument is that a graduated strip, embodying the different colors taken on by heated bodies, is passed over a diffused light. The price of the instrument is $25.

The Minnesota Testing Laboratories, Inc., is a consolidation effected by Crowell & Murray, consulting engineers and lower lake port chemists; Lerch Brothers, analytical chemists, with branches on the Mesabi, Cuyuna and Michigan iron ranges, and the Duluth Testing Laboratory, of which C. A. Graves is director. The officers of the new organization are: President, Benedict Crowell; vice-president, Fred Lerch; secretary-treasurer, C. A. Graves; manager, K. M. Way.

A new steel company—Halcomb & Davidson, Inc.—with offices in the Singer Building, New York, has been formed by C. Herbert Halcomb, formerly a director and works manager, and William P. Davidson, for 11 years vice-president and general manager of the International High Speed Steel Co., who have severed their connections with that company. The new company will engage in the manufacture and sale of all kinds of tool steel, high-speed steel, alloy steels and drill steels, solid and hollow.

Editorial Correspondence

SAN FRANCISCO—Apr. 19
(By Telegraph)

Comstock Opening Old Union Shaft to 2,700-ft. level. When completed, Superintendent Symmes will probably report advisability of unwatering Northend mines to 2,900-ft. level, as high-grade ore is already disclosed. Water is now only 6 ft. below 2,700-ft. level.

SAN FRANCISCO—Apr. 15

Highgrading of Tungsten at Atolia has resulted in the arrest of 8 men, chiefly Italians. Five of them were found guilty and three are out on bail. The penalty was 120 days in jail or a fine of $120. Judge Taylor did not consider a highgrader's time worth more than $1 per day unless he was on the job. One of these thieves had tied the bottoms of his trousers at his shoetops and carried the rich ore inside around his ankles.

The Activity of the Oil Industry in the development of new wells since the beginning of the year 1916, was sustained in the past week which saw recorded 20 additional wells, making a total of 163 since the first of the year, reported by the State Mining Bureau. The area of proved oil land in California just determined by the Bureau, is reported at 126 sq.mi. or 80,702 acres, divided among the oil producing counties, as follows: Kern, 55,842 acres; Fresno, 12,218; Santa Barbara 6,030; Orange, 3,305; Los Angeles, 2,326; Ventura, 749; San Luis Obispo, 202; Santa Clara, 30.

Quicksilver Thieves Have Been Operating in Napa County, at the Aetna mine, and in Santa Clara County at the Guadalupe mine. The recent high price of quicksilver which advanced beyond $300 per flask offered temptation to thieves who were more adept at stealing than disposing of quicksilver. In Napa County, A. Sark has been charged with the theft from the Aetna mine and trial set for Apr. 25. The thieves who robbed the Guadalupe have not been apprehended, but detectives claim to have secured a clew to the well organized gang, through the efforts of a woman who understook to collect payment for the quicksilver, said to have been stolen from the Guadalupe.

Water Rights in Eldorado and Sacramento Counties, owned by the Hayward-Hobart-Lane interests, have been in litigation for a long time but the recent decision of the General Land Office, affirming the decision of the Sacramento Land Office, awarded to E. R. Walker the right to establish a reservoir and dam site on the middle fork of Cosumnes River. The decision is final and closes the litigation pending since September, 1912. At the final hearing, T. H. Patton, the contending claimant, allowed his claim to go by default. Walker has expended $25,000 on the project. Approximately coincident with the decision of the Land Office in this case, another one which has been pending in the Superior Court of Eldorado County, was practically terminated by the withdrawal of Ray C. Beal from the legal fight to maintain possession of the extensive water system, purchased by the Placerville Gold Mining Co. It is reported that Beal relinquished possession, discharged all his employees and is closing up the office. The employees of Beal were then reemployed by the Placerville Gold Mining Co. and sent out to repair the water system. A concrete dam, at the head of the Gold Hill ditch in Placerville, was begun and it is believed that the mining company will now proceed to complete repair work and get in a position to resume development of the mine situated within the town of Placerville. The mining industry of Eldorado County has been greatly retarded by controversies over the water rights and the use of water; and these two settlements, if they are final, should serve to encourage the investment of money in this county for the reopening and development of mining properties.

DENVER—Apr. 14

Silverton Keeps on Reporting Tungsten Discoveries, recent ones being on Red Mountain, Mineral Point, head of Cascade Creek, near Gladstone, and close to Silverton on the slope of Sultan Mountain. Pueblo men are said to have discovered this metal in their Tip Top claims well up on the Sangre de Christo range about 8 mi. east of Crestone.

The Cripple Creek District furnishes the following current items of interest: The Dante mine on Bull Hill has been taken under a 5-yr. lease by the Consolidated Mines and Reduction Co. The Pharmacist mine, also on Bull Hill, and the first dividend payer in the district, is being newly developed by lessees and gives promise of again becoming prominent. Dump at the main shaft of the C. O. D. mine close to City of Cripple Creek is to be worked over by the flotation process; inasmuch as this dump was accumulated during early years of the district's history, it probably contains much material valuable under present conditions. The Eagle ore company at its annual meeting elected the following officers and directors: G. S. Wood, president; Irving T. Snyder, vice-president; A. W. Oliver, manager; George A. Stahl, secretary; K. V. Simson, cashier; Nelson Franklin, A. J. Zang, T. B. Burbridge and W. G. Eldred, directors.

Miners' Wages in the Leadville District have been raised 10% voluntarily by the operators. The camp promises to be the busiest it ever has been. In addition to the reopening of many old mines, the district is now to be considered by placer operators. The Derry Ranch Gold Dredging Co. has resumed operations for the season on its large tract along the Arkansas River a few miles south of town. The dredge built last summer was operated a few weeks with most satisfactory results before being obliged by winter to shut down. The boat is now digging although its pond is covered with ice. The success of this venture in a new field gives stimulus to owners of neighboring tracts to inaugurate similar operations. The Western Zinc Oxide Co. has decided to enlarge its smeltery by adding a new block of furnaces to handle non-sulphide ores, and a roasting unit to treat sulphides. A three-years' contract has been made with lessees of the Gallagher mine to supply this company with carbonate ore; while the Midland Chemical Co. of Chicago, is reported to have purchased one-fourth of the entire stock of the company to assure itself an ample supply of oxide required in the manufacture of lithopone.

BUTTE—Apr. 15

Butte's Payrolls for the Month of March were the largest in the history of the district. The total payrolls including those of the business houses, public utility corporations and other concerns as well as the rolls of the mines, made a total for March of close to $3,000,000. This does not include the payrolls of Anaconda where in the Washoe smelter alone over 5,000 men drew salaries aggregating over $500,000. The payrolls in Butte were based on the sliding scale that gave the miners $4.25 per day. The Anaconda company paid out for labor in its Butte mines alone $1,407,000. The Butte & Superior had the largest payroll in its history amounting to $251,000. The North Butte rolls called for $140,000. The payrolls of the Timber Butte Milling and the Elm Orlu Mining company, the two Clark companies, amounted to about $100,000. It is claimed that the total of payrolls of the Butte miners has more than doubled in the past 14 months.

The Montana Power Co. Has Announced that the work on the new 40,000-hp. plant at Holter on the Missouri River near Wolfe Creek, is to be rushed to completion not later than August of next year. It has also announced that work will begin at once on another great power in Southern Montana and this will be finished late next year. When but three years ago the Montana Power Co. announced its intention of constructing a 90,000 hp. hydro-electric development at the Big Falls of the Missouri near Great Falls and also a 60,000 hp. plant at Thompson Falls in the Clark's fork of the Columbia River, many of the leading financial men declared that it was extravagance, for such quantities of power would not be needed in Montana for years to come. The late Max Hebgen, general manager of the Montana Power Co. and the late John G. Morony, one of the leading financial men of the company, had hard work convincing some of the directors that it was wise to go ahead with the plants. They pointed out that if the work was carried on at a moderate pace, it would take four years to complete those plants. The first two had not been more than started, however, when the sudden demand for more electrical power became so urgent that the work was hurried and both plants are now in full operation. The great changes along both metallurgical and mining lines are largely responsible for the increased demand for power. At both the Washoe smelter and the Reduction works at Great Falls, the power demands have more than trebled. The new copper refinery at Great Falls, the zinc refinery and reduction plant at Anaconda, and the new zinc refinery at Great Falls

have alone added greatly to the power requirements. The mines of not only Butte but of all western Montana have also added greatly to the power requirements. Practically every mine in Montana that has ever been listed as a producer, is now in operation. Railroad electrification has counted some but the requirements of the Milwaukee R.R. in this respect have not been extensive so far. They will increase constantly, but the Montana Power Co. will have its new plants completed in time to care for those requirements. The growth of Butte and other mining centers has added to the demands for light and power for commercial purposes but this growth has been nothing in comparison with that of the mining industry. The figures showing the gross and net incomes of the company for March of this year compared to March of 1915 show an increase in the gross income of $170,000 or nearly 60%; the net income increased $146,000 or over 70%.

SALT LAKE CITY—Apr. 15

The Net Proceeds and Assessible Property of the Silver King Coalition of Park City for 1915 as filed with the state board of equalization were stated at $782,069. Gross proceeds for the year were $1,883,483, and expenses $1,101,413. A considerable part of the latter item was spent in repairs and improvements. The statement of the Utah Consolidated Mining Co., owning the Highland Boy at Bingham, showed net proceeds for 1915 to have been $1,743,408, and gross proceeds, $2,298,656.

The Cleanup at the Tintic Milling Co. Plant at Silver City marks an advance in the development of the milling process, which this company is applying to low-grade Tintic ores. It is expected that the recovery from the precipitation boxes will show whether any changes in the method of treatment will be necessary. A thorough cleanup will not be undertaken at this time; and exact deductions as to costs can not be made. Three Holt-Dern roasters have been in operation, and their work has been under observation, with intent to make such improvements as are needed; they are stated to be giving satisfaction. There is one Knight-Christensen roaster at present being tried out. The mill is constructed so as to permit of adding units as they are needed. Working at capacity it will treat 300 tons daily, employing about 25 men. The greater part of the ore at present being treated comes from the Dragon Consolidated. The company is now employing about 40 men, some of whom are working on construction.

MORENCI, ARIZ.—Apr. 14

If the Recent Advance in Smelting Charges is not modified many Arizona mine owners and operators claim they will have to shut down. In the new schedule, the former 2½c. deduction from the market quotation is added to by ¼c. for each cent above 14c. selling price. Thus when copper sells at 26c. the producer will only receive 20½c. There is also a deduction of 20 lb. copper to the ton of ore running 10% or less, which reduction was formerly 10% of copper content, with 12 lb. as a minimum. The minimum charge for treating a ton of ore is increased from $2.50 to $5, and the reduction for moisture is raised. The risk of buying copper at such an abnormally high price is given by the smelters as their reason for the advancement. And as every smelter in the district is swamped with ore, it is not thought that any modification in the rates will be made soon.

The Latest Verde Company in the Jerome district is the Verde Combination. The new company, which is in the process of organization, owns 900 acres paralleling the Green Monster on the north and adjoining the United Verde and the United Verde Extension on the south. Copper sulphides have been opened in 10 places at different depths. One shaft is down 670 ft. and shows ore at the 300- and at the 630-ft. points. Another 360-ft. shaft has a 3-ft. vein of sulphide in a 300-ft. drift on the 260-ft. level. An outcrop crosses the property a distance of 5,000 ft. and has been slightly developed in several places. Jas. M. Layman, who organized the Green Monster, is behind the Verde Combination.

GLOBE, ARIZ.—Apr. 15

The Old Dominion Management Is Considering an increase of its milling capacity to 1,000 tons a day and the addition of a reverberatory furnace. President Smith, who is now here, states there has been consideration of a plan for reconstructing the whole smelter, though no decision is expected on the matter for some time to come.

DOUGLAS, ARIZ.—Apr. 13

General Calles, Military Governor of Sonora, has ordered a raise of the export duty on copper from 0.8c. per lb., gold, to 1.5c. This is expected to secure a revenue for Sonora, from this single item, of $52,000 a month at the ports of Naco and Agua Prieta, from the shipments of the Cananea and Moctezuma companies. Both are working around capacity and are furnishing profitable employment to thousands of erstwhile revolutionists. Calles has guaranteed protection and is supposed to be fostering with all his power the development of any industry that will return prosperity to his bandit-harried State. To the receipts of the Moctezuma Company are being added ore shipments from the noted old Promontorio property, now held by the Phelps-Dodge interests. The ore is brought to Nacozari on mules, of which 400 are now used and the number is soon to be increased.

JOPLIN, MO.—Apr. 15

Ground Has Been Broken at Weir City, Kan. for a new two-block zinc smeltery, and construction work will be pushed. It is being erected by C. W. Squires, a prominent mining man of Galena, Kan., and J. L. Taylor and Frank Curnor, of Pittsburg, Kan. Curnor will be manager for the plant.

The New Smeltery at Fort Smith, Ark., is being rapidly constructed by the Vogelstein interests. Every available man or team in that city is said to be working on the smelter site. The mains for piping the natural gas to the plant are being put in. It is stated that the present plans contemplate enlarging the plant by units, one block at a time being built and put into commission as quickly as built.

The Bertha A, Wingfield and Athletic Mines are now operated by C. T. Orr. At the Bertha A, a slime plant is being operated which is saving an additional two tons of concentrates per day from about 1,000 tons of rock milled. Mr. Orr contemplates installing a fine-grinding and slime-concentrating plant and may eventually install an oil-flotation plant. The American Zinc, Lead and Smelting Co. is now making experiments with oil-flotation on its ores and is presumably meeting with success.

The Sheet Ground Areas of the Joplin-Webb City district are furnishing most of the zinc mined in the region. The upper stratum of the sheet ground is richer in zinc and lead than the lower. During normal prices, leasers worked out the upper stratum and in a great many instances left below from 5 to 12 ft. of zinc-bearing chert of a lower grade. Some of the operators are now cutting out this lower stratum of chert at a very low mining cost. The average yield of all sheet ground under the present system of milling is very little over 2% in concentrates, and it is safe to say that a recovery of not over 70% is being made. The miners are now receiving wages on the sliding-scale basis of a 25c. per day increase for every $10 increase in the base price for zinc concentrates. The average wage with zinc concentrates from $100 to $110, including contract shovelers, is between $4.50 and $4.60 per day, which probably makes the Joplin district one of the highest wage paying camps in the country. Shovelers are now receiving 10c. per can, which makes a cost of about 20c. per ton for shoveling and tramming to the shaft. Under normal conditions the price is about 6 to 6½c. per can. The wage scale effective with 60% zinc concentrates at $100 to $110 per ton is: Powderman, $4.50; powderman's helper, $4; tub hooker, $4.50; machineman, $4.25; machineman, tripod, $4.50; machineman, helper, $3.75; machineman, tripod helper, $4; shoveler boss, $4.50; trackman, $4.25; trackman helper, $3.75; mule driver, $3.75; brunoman, $3.25; pumpman, $3.75; tub runner, $3.25; pig tail, $3.25; roofman, $4.25; blacksmith, $4.25; blacksmith, helper, $3.75; hoisterman, shaft, $4.50; hoisterman, tram, $3.25; jigman, day helper, $4.25; jigman, night helper, $4.25; sludgeman, $3.45 for 10-hr. day; for 8-hr. day, 25c. less; sludgeman, night, $3.45; crusher feeder, day, $3.45; crusher feeder, night, $3.45; cullhand, $3.05; engineer, day, $4; engineer, night, 4; roustabout, $3.05.

DULUTH, MINN.—Apr. 17

Navigation at the Head of the Lakes Opened on Apr. 14. The "Briton," of the Massey Steamship Co., left Duluth for Port Arthur or Ft. William to load screenings. Ore is arriving at Duluth and Superior docks from the Vermilion, Mesabi and Cuyuna ranges, but thus far no boats have been loaded. At Sault Ste. Marie the Canadian canal is open, but the American canal will not be open for several days. The ice crusher "Algoma," under charter to the Canadian Government, is opening up navigation around the Sault and it is possible some ore carriers may start down within the next 10 days. Employment agents report plenty of labor available.

HOYANFORD, NORWAY—Mar. 25

Aluminum Smelting Is to Be Done near here, where waterfall is being developed to furnish 20,000 hp., with a possibility of 60,000 hp. later. Estimated capacity given at 4,000 tons aluminum per year [power developed should be sufficient to produce 18,000 tons.—Editor.] to be produced from French bauxite. Capital stock understood to be about $3,300,000.

The Mining News

ARIZONA

Cochise County

HILL TOP (San Simon)—The 3,000-ft. tunnel, which will enable shipping over Southern Pacific R.R. from San Simon, almost completed. Tunnel discloses good ore, as does 800-ft. shaft. Principle owners are P. J. Kasher, Chicago, and J. O. and R. O. Kyle, Kansas City.

Gila County

ARIZONA ASBESTOS (Globe)—R. L. Shumate, representing H. W. Johns-Manville Co. and E. O. Christiansen, acting for W. Putman, Boston, manufacturer of asbestos products, are examining property with intent to purchase.

APACHE MOUNTAIN DEVELOPMENT CO. (Globe)—Close corporation with capital stock of $100,000, organized by G. H. Hayes, Henry V. Snell and John S. Cook, to take over Stonewall Jackson silver mine, 18 mi. west of Globe. Hayes has sunk one shaft 540 ft. deep and driven several crosscuts and tunnels on 470-ft. level. Shaft will be sunk deeper.

Greenlee County

SHANNON (Clifton)—March production 682,000 lb. copper for 24 days' operation, compared with 666,000 lb. for February for 16 days' operation.

Mohave County

UNITED WESTERN (Oatman)—Struck 6-ft. vein assaying $25 per ton; will install new hoist.

BIG JIM (Oatman)—Shaft down 500 ft.; crosscut will be driven expecting to cut vein at 140 ft.

OATMAN QUEEN (Oatman)—Rich shoot struck at 130-ft. depth in incline shaft being sunk on vein.

SUNNYSIDE (Oatman)—Shaft down 130 ft. on vein showing good assays; hoisting machinery will be installed.

GOLD RANGE (Oatman)—Compressor and drills installed; three shifts will be worked till shaft reaches 500-ft. point.

LUCKY BOY (Oatman)—Shaft down 200 ft. struck many gold-bearing stringers of quartz and spar; three shifts being worked.

ARIZONA GOLD STAR (Oatman)—Hoist, compressor and other machinery installed; 100-ft. shaft will be continued to 400-ft. depth.

LAZY BOY (Oatman)—Shaft down 300 ft.; 60-ft. crosscut disclosed 10-ft. vein at contact of rhyolite and andesite that pans gold throughout.

ADAMS (Oatman)—Crosscuts and drifts on 50-ft. level of prospect hole show good ore; sample taken from entire face of one drift assays $13.58 per ton gold.

TOM REED (Oatman)—Drift on 400-ft. level continues to cut high-grade stringers; company plans new working shaft.

OATMAN GOLD (Oatman)—Crosscutting from station on 500-ft. level begun; will be driven 100 ft. to intersect vein that shows good gold assays on 300-ft. level.

BLUE BIRD (Oatman)—Claims transferred from Big Jim to new company which will develop same at once. Twenty men are at work erecting buildings to accommodate large crew miners to be put at work.

LORENZONA ORE PURCHASING AND REDUCTION WORKS (Oatman)—New organization to handle concentrates and ores in entire Mohave County district; will afford local market to small operators who have insufficient ore developed to warrant installation of mill.

Pima County

VULCAN (Mineral Hill)—New hoist installed; producing 40 to 50 tons 6% copper ore daily; two shafts down 100 ft.

Yavapai County

WICHITA PLACER (Prescott)—Heavy machinery installed; hydraulic operations will be started at once.

DUNKIRK (Prescott)—Mill operating steadily, saving 90% by flotation; compressor recently installed to facilitate deep development.

DUNDEE-ARIZONA (Jerome)—Company organized and financed to take over and develop two patented claims owned by F. S. Stevens and William Mackey has issued 500,000 shares of $1 par value, of which owners retained 257,000 shares, while investors identified with Phoenix National Bank took remainder. Property is entirely surrounded by Verde Extension and Jerome Verde and has same surface indications as former. Shaft down 200 ft. and sinking at rate of 3 to 4 ft. a day.

CALIFORNIA

Amador County

SOUTH BANNER (Oroville)—High-grade ore reported struck on 350-ft. level.

SUTTER CREEK (Sutter Creek)—Unwatering old shaft at hill top with intent to prospect ground north and south of it.

HARDENBERG (Jackson)—Present owners agreed to conditions proposed for reorganization by New York men, reported ready to invest in property.

FREEMONT (Dry Creek)—Deepening shaft additional 400 ft. to 2,750-ft. point progressing. Recent work in lower levels indicates persistence of orebodies.

PLYMOUTH CONSOLIDATED (Plymouth)—Survey and other preparations for construction of new cottages to be occupied by employees are in progress. In conjunction with other mine operators on Mother Lode, company raised wages voluntarily 25c. per day.

TREASURER (Amador City)—Hardinge mills being installed. Mine reopened two or three years ago developed and sampled before decision reached as to best metallurgical method to adopt. Recent decision favored installation of Hardinge plant. J. H. Bell is superintendent.

ROBINSON (Berdan)—Property being developed under direction of J. Allan Veatch with 15 men working three shifts. Pay gravel reported found. Claim controlled by Royal Drift Co., which also has option on Straughan, Best, Double Eagle, Big Butte and Boston Hill claims, all near Robinson. Activity in camp has induced petitions for reëstablishment of Berdan Post Office.

Calaveras County

SUMMERVILLE (Angels Camp) — Double-compartment shaft down 230 ft. Crosscut on 215-ft. level extended 70 ft. and shows 5-ft. vein carrying good ore. Installation of electric hoist and a 1,500-ft. aërial tramway contemplated.

BUND COPPER (San Andreas)—Lease taken by Harry Norman, James Tragen and Victor Cuneo. Mine property prospected in early days of copper excitement by two shafts to 175-ft. depth. Vein varies from few inches to 2-ft. width; ore reported high-grade copper.

PIONEER CHIEF (Valley Spring)—Lumber for new surface buildings being hauled, and installation of mill will soon start. Company purchased Kane ranch chiefly for water. Good grade ore reported disclosed in 350-ft. level. Mine equipped with electric hoist, compressor and air drills. J. E. King is superintendent.

TULLOCH (Angels Camp)—Recently bonded by Thomas Lane, who is making important changes and improvement. Electric power equipment being installed comprising 75-hp. and 25-hp. motors and four 25-kw. transformers. Old ore bins being replaced by new. Installation of mill contemplated. About 20 men employed.

Kern County

CONSOLIDATED MINES (Randsburg)—Leasers prospecting along south line of property discovered 2-ft. width scheelite. From Feb. 22 to Apr. 8, leasers mined approximately $20,000 worth tungsten and sold $7,000 worth high-grade. Headframe and hoist being installed. Company has begun installation of tungsten milling plant in connection with stamp mill. Plant will include Cornish rolls and three tables; capacity about 40 tons per day. S. J. Tyler, superintendent has leased several tungsten claims and expects to do custom milling.

San Bernardino County

LEONARD (Atolia)—Largest tungsten nugget yet found in region, weighing 142 lb., was taken from property by F. B. and F. E. Alvarez and J. L. Lozano. Offer of $4 per lb. was refused. Property about 2½ mi. from Atolia mill.

ROSE FRACTION (Atolia)—Fred Weise, owner, recently sold 700 lb. of high-grade tungsten mined within a week. Peterson and Kearn, leasers on property, are averaging 20 lb. float per day; one piece found weighing 11 lb.

Siskiyou County

QUARTZ HILL (Scott Bar)—Full crew of men operating with two 4-in. nozzles under 350-ft. head.

COLORADO

Boulder County

VASCO (Boulder)—Announced advance in schedule of tungsten prices paid for ore mined by lessees on company property to $37.50 per unit on 60% basis.

Clear Creek County

AETNA (Georgetown)—Lessees in west drift on Aetna vein opened 2-ft. vein copper-lead ore worth $70 a ton.

FREELAND (Freeland)—William Traylor, leaser, opened a 6-in. vein rich lead ore, assaying 50% lead, within 20 ft. of surface.

CLIMAX (Lawson)—A 12-in. vein high-grade gold and silver ore opened, estimated to have average assay of $100 a ton. J. N. Calden is manager.

STANDARD (Idaho Springs)—Sold by W. T. Chappell to Cleveland, Ohio, capitalists for reported $100,000. New owners will remodel mill and install flotation equipment.

ALBRO (Idaho Springs)—Recent development has opened ore, having average assay of $80 a ton in gold, silver and lead. Crosscut driven 260 ft. to intersect Albro vein at 100-ft. level. About 600 ft. drifting finished, mostly in ore.

Teller County

C. O. D. (Cripple Creek)—Considering proposal to treat dump at main shaft in Poverty Gulch by flotation process installed in mill to be erected.

OSTON LEASING (Elkton)—Developing large oreshoots in second, third, sixth and seventh levels of Thompson shaft of Elkton Con. Width of main-vein orebody 10 to 35 ft.; average assay, $8 per ton. Company will ship 2,000 tons to Golden Cycle mill at Colorado City during April. I. J. Russell is superintendent.

EL PASO (Victor)—If company does not build mill with flotation process it may lease right to treat low-grade ores on a 15% royalty basis. During past year 4,230 ft. of development work has developed about 20,000 tons of ore. Lower levels, including tunnel level on C. K. & N. vein, have developed low-grade ore. Extensive development planned for upper levels. Joseph J. Darnell is superintendent.

CRIPPLE CREEK GENERAL MINING AND EXPLOITATION (Cripple Creek)—Company incorporated with capital of $200,000, divided into 2,000,000 shares, has secured control of Kittie Hollis, Missouri Placer, Holy Terror, Unexpected and Little May properties, aggregating 25 acres. Directors are George S. Ryan, president; E. A. Ritter, H. C. Hamman, S. N. Francis and O. H. Nelson. E. A. Ritter is manager and P. P. Barbour is superintendent.

CONSOLIDATED MINES AND REDUCTION (Victor)—Has secured control of Dante mine under five-year lease. Nine known veins partly developed. New mill being constructed to replace the cyanide mill destroyed by fire will treat ores from company's properties, also custom ore. Company now developing five properties including Dante, Ella W., Kittie Wells No. 2, Buckhorn, and Tenderfoot Hill. Ella W. shaft sinking with three-shift crew now 52 ft. below tunnel level and electrically operated hoisting plant being installed. Ella W. vein opened 7-ft. width of high-grade ore.

IDAHO

Shoshone County

BURLINGTON (Wallace)—Contract let to S. J. Stimson to extend lower tunnel 300 ft. Will install compressor.

NORTHERN LIGHT (Pine Creek)—Reported to have proved oreshoot 450 ft. long on 200 level and now sinking shaft to 400.

NATIONAL (Mullan)—Four cars concentrates, worth $116 a ton, shipped in March, and operations will probably show small profit, for first time in history of mine. Strike of 2 ft. high-grade chalcocite reported on 800- and 1,000-ft. levels.

HERCULES (Wallace)—Treating more than 1,000 tons daily in mill designed for 500; feed carries about 15% lead, 12 oz. silver, and varying amount of zinc. Most of concentrate is of comparatively low-grade, object being to save as much iron as possible as flux for Northport smeltery. Recent installation of Janney flotation machines making good saving of lead, but having difficulty in saving zinc.

INTERSTATE-CALLAHAN (Wallace)—March shipments were 6,700 tons, of which 600 tons were lead concentrates and 6,100 crude zinc ore and concentrates averaging 50% zinc. Preliminary estimates place net earnings at $325,000 as against $278,000 for February. Concentrator designed for 300 tons, daily treating 400 tons, with recovery of 92%. Plans being prepared for 1,200-ton mill to be erected on 120-acre site at Enaville.

SUCCESS (Wallace)—Stockholders elected following directors: P. J. Gearon, James Gearon and L. C. Wilson, all of Wallace, and E. H. Becker and C. M. Carroll, both of Spokane. Criticism of management recently met by adoption of resolution strongly endorsing it. Report on physical condition of mine prepared by Arthur B. Clark, mining engineer of Butte, was read, according to which 108,200 tons ore available in mine, and there are strong indications that oreshoot will continue to great depth. New directors organized by reëlection of P. J. Gearon, president and general manager, James Gearon, vice-president, and L. C. Wilson, secretary and treasurer.

MICHIGAN

Copper

HANCOCK (Hancock)—Encountering heavy mass in No. 7 shaft.

MOHAWK (Mohawk)—March production 60,924 tons rock; recovery, 1,540,900 lb. refined copper.

WOLVERINE (Kearsarge)—March production 32,092 tons rock; recovery, 577,682 lb. refined copper.

SOUTH LAKE (Houghton)—Opening at 600-ft. level driven east has struck Butler lode formation, showing commercial copper.

FRANKLIN (Demmon)—March production 274,000 lb. refined copper. Company has sold output for remainder of calendar year.

KEWEENAW (Mandan)—Underground developments rapidly extended now total 2½ mi. in amygdaloid. Stock pile contains 15,000 tons rock. Mill expected to start in June.

VICTORIA (Victoria)—New shaft opened down to 17th level expected completed to 26th by July 1. Rock produced from first nine levels as shaft now equipped only to 10th level. March production about 100 tons mineral.

SENECA (Calumet)—Syndicate composed of Thomas F. Cole, of Duluth, Tucker, Hayes & Bartholomew and associates secured 60% company stock. New corporation will be organized with 200,000 shares, of which 95,000 will be exchanged for 20,000 old-company shares. Holders of 8,000 shares will be offered $60 per share cash or four shares new stock. Treasury fund of $1,000,000 thus provided after payment of all debts. Thomas F. Cole, president, W. J. Uren, general manager.

Iron

ASHLAND (Ironwood)—Large electric driven compressor installed capable of supplying air to 50 drills.

IRON MOUNTAIN LAKE (Ishpeming)—Mine buildings and 30 dwellings will be erected. Shaft started last year will be sunk to 600 ft. and another shaft possibly sunk later.

HOLMES (Ishpeming)—Headframe will be 130 ft. in height, or 20 ft. higher than standard headframe of the Cleveland-Cliffs Iron Co., the owners. Shaft now down about 130 ft.

TRADERS (Iron Mountain)—Ore being loaded into cars from pit and shipped to Escanaba. Force will be increased shortly. Contracting firm is rushing work removing overburden from one end of pit so not to delay mining.

OLIVER IRON (Ironwood)—Large turbine will be installed at Pabst mine. Pumps, hoists and compressors at Pabst, Aurora, East Norrie and Norrie mines will be operated by electricity. New shaft will be sunk near present Pabst shaft. Expenditures will reach $1,000,000. Believed that big saving will result from having one central electric plant instead of four separate steam plants.

MINNESOTA

Duluth

GREAT NORTHERN (Duluth)—Trustees thus far contracted for sale of over 1,100,000 tons. Planned to mine most of this tonnage from properties owned in fee by organization, taking from leased properties only minimum stipulated in leases.

SOO DOCK (Ashland, Wis.)—Contract let to Foley Bros. Construction Co., St. Paul, for dock at approximately $1,250,000. Contract calls for completion by Spring of 1917. Dock will have storage capacity of 50,000 tons, with 75 pockets on each side.

Mesabi Range

THORNE (Buhl)—New steam shovel, Osgood Model 73, being set up for use.

UTICA (Hibbing)—Work started on new 85-ft. steel headframe; Albany will also have similar one.

PERKINS (Mesaba)—Will operate at once, with one shovel in pit; 10,000 tons ore will be shipped by May 15.

HANNA (Mountain Iron)—Mining started about edges of pit at Hanna A mine. Hanna B also operating by slicing methods under banks.

ARCTURUS (Marble)—Three shovels working both shifts in development work. Spur track from Hill mine completed, making Hill mine shop headquarters.

NORTH UNO (Hibbing)—Underground mining into pit in progress. Ore hoisted in incline shaft with 45-hp. 3-cylinder gasoline hoist, only one on range.

HARTLEY (Chisholm)—Stripping operations now starting with one shovel and other will be added later. Property has been test-pitted during winter.

LEONARD (Chisholm)—Over 400 men employed. Ore mined from drifts into pit will be removed by steam shovels after stripping season opens. Expecting two new shovels.

OLIVER (Hibbing)—Will work all properties in Hibbing district to capacity, Hull-Rust being leading shipper. Sheridan mine stripped last year will produce about 500,000 tons.

ORDEAN (Virginia)—One shovel now stripping and another will be added soon. Oliver company will strip 750,000 yd. overburden and probably 200,000 tons ore will be shipped during season.

STATE MINES (Hibbing)—State leases will operate to good capacity; shipments may total 4,000,000 tons. Grant at Buhl, Leonidas at Eveleth, Missabe Mountain, at Virginia were leading shippers last year.

SHENANGO (Chisholm)—Everything in readiness for pit to produce about 150,000 tons more than last season. Underground producing at rate of about 25,000 tons a month. New steel headframe erected.

MISSABE MOUNTAIN (Virginia)—Twelve drills at exploration work on this state property lease to get information for stripping operations. Property is one of largest state leases; tax commission gives tonnage as about 20,000,000.

ALPENA (Virginia)—Ore removed by milling process being hoisted through No. 2 shaft. Three shifts total 400 employees. Stockpile will be shipped this summer. New motors ordered for electric haulage. End of coming season will see property practically exhausted.

WEBB (Hibbing)—Shenango Furnace Co. has awarded contract to Winston & Dear to strip property adjoining Buffalo & Susquehanna pit. Machinery being assembled for stripping. Large washing plant will be built since ore carries considerable waste.

HAROLD (Hibbing)—New shaft recently completed. Work gradually closing down so that about one-half number of men now employed will work during coming season. Great Northern iron ore properties cannot obtain boats to ship all they can produce, hence operations curtailed.

SHIRAS (Buhl)—Oliver company operating this underground mine. Addition built to mine dry, increasing capacity from 50 to 150 lockers. Addition to engine house completed, to make room for direct connected 50-kw. generator for haulage and lighting. New 4-ton Goodman motors received.

MISSOURI—KANSAS—OKLAHOMA

GREENHORN (Duenweg, Mo.)—R. L. McGee sold mine to Frank Brown for a reported consideration of $20,000.

D. C. & E. (Oronogo, Mo.)—Has taken leases on 160 acres south of Oronogo; preparations being made to reopen several old mines on tract.

FOUR JACKS (Spurgeon, Mo.)—First shipment made from new concentrating plant. Mine operations conducted at depth of only 50 ft. and dirt averages about 5%.

UNITED ZINC (Joplin, Mo.)—Will be unable to operate three centrifugal pumps installed at Peacock camp till electric power company completes installation of new turbine at Riverside in near future.

EMPIRE (Galena, Kan.)—Flotation plant of 15 tons' capacity ready for operation. Installed by George Belchic, of the Kansas University Research Department, who has been conducting experiments in district for some months.

UNDERWRITERS LAND (Joplin, Mo.)—Upraised shaft being started at Geronimo mine west of Joplin; will tap part of leases touched only by drift, but which drilling campaign last summer showed to contain good sheet-ground ore.

MONTANA

Fergus County

NORTH MOCCASIN (Kendall)—Barnes King company treated 3,406 tons ore in March, with estimated production of $33,700, or $9.89 per ton, or 78c. per ton higher than February average.

Lewis and Clark County

PIEGAN-GLOSTER (Marysville)—March production was 2,842 tons, an increase of 305 tons over February. Bullion returns $12,400, an increase of $600, while yield per ton was $4.36, a decrease of 29c. from February returns.

BLUE BELLE (Helena)—Capital Exploration Co., with $40,000 capital, incorporated by C. J. Kelly, L. O. Evans, D. Gay Stivers, H. A. Gallwey and H. G. Rickerts, all of Butte, to operate Blue Belle and adjacent claims in Scratch Gravel District. Contract let for shaft to be sunk on vein.

Silver Bow County

BUTTE-DETROIT (Butte)—Orders given Manager Creden to prepare for resumption of work at Ophir mine.

BUTTE & BACORN (Butte)—Announced that $157,620 of a required $264,000 subscribed to reorganization plan.

BUTTE-DULUTH (Butte)—District Court granted order to sell property, or as much as necessary, to satisfy labor claims, amounting to $42,000.

DAVIS DALY (Butte)—New hoist engine will be a Nordberg with capacity to hoist 1,100 tons in 16 hr. Contract requires readiness for operation by Sept. 1.

PILOT (Butte)—Anaconda company preparing newly acquired property for operation. Three shifts began work recently, and soon as repairs made, mining operations from 1,800- to 2,600-ft. level will begin. Shaft will be retimbered from 2,200- to 2,600-ft. level, considerable crushing being apparent here due to passing through Poser fault.

NORTH BUTTE (Butte)—Will soon start development of large area of mineral land in eastern section of Butte district, about three times as large as area owned on Anaconda hill. Preparing to mine in this eastern territory about 1,200 tons daily low-grade copper ore averaging 1½ to 2% copper, which will add nearly 1,000,000 lb. copper to normal monthly output.

ANACONDA (Butte)—Due to undermining action of water poured into stopes in Pennsylvania mine, where fire is burning, expected cave-in occurred recently in fire zone, necessitating temporary abandonment of work and hoisting of miners when first evidence of cave was noticed. Fire now entirely confined by bulkheading between 1,000- and 1,300-ft. levels, and extinguished entirely on 1,400-ft. level.

BULLWHACKER (Butte)—Lease and option to Wall & Heilbronner, of Butte, who transferred it to East Side Mining Co., ratified at recent meeting of stockholders. Lease calls for shipping not less than 1,000 tons ore per month and royalty of 25%. From Mar. 5 to 31, 2,586 tons shipped to Salt Lake and Tacoma smelters. From first four cars net returns amounted to $763. Estimated that hereafter profits will run about $250 a car or $1,000 per day.

BUTTE & SUPERIOR (Butte)—Development on 1,600-ft. level has shown width of Black Rock orebody to be 80 ft. Ore said to contain 25% zinc, 8 oz. silver and small amounts of lead and gold. After deducting mining and milling costs at rate of $5 per ton, ore is worth $40 at present price of spelter. About 1,250,000 tons blocked out, representing present value of $50,000,000. Mill now treating from 1,800 to 2,000 tons a day with recovery from 94 to 95 per cent.

NEVADA

Esmeralda County

SOUTHWESTERN MINES (Hornsilver)—Formerly Great Western property has produced about $125,000. Engineers making examination to determine advisability of erecting mill; considerable mill ore blocked out.

JUMBO EXTENSION (Goldfield)—Shipments continue at rate of about 100 tons per day. New ore selling contract in effect Apr. 10 expected to effect saving of about $7,000 per month on present production. Main east crosscut 1,017-ft. level connected with Merger working in Sunflower claim.

GOLDFIELD CON. (Goldfield)—As a result of extensive laboratory tests coupled with investigation of flotation plants in other camps, the company in February erected, at its 100-stamp mill, an experimental flotation unit for treatment of low-grade copper ores. Unit consists of three Callow cells. At present but two, in series, being used fed from classifier in closed circuit with tube mill. Copper recovery about 93% on $7 to $8 ore.

Storey County

MEXICAN (Virginia)—Prospecting crosscuts 2,500 and 2,700 levels in porphyry and quartz of low assay. Mill crushed 483 tons custom ore, gross value about $7,000.

SIERRA NEVADA (Virginia)—Saved 114 tons of ore, averaging $9.54 from 2,500 level No. 1 stope. West crosscut from bottom of winze extended 4 ft.; north and south drift from crosscut extended 8 ft.

UNION CON. (Virginia)—Extracted 369 tons of ore, gross value about $6,000, from 2,400 level No. 4 stope, 44 tons, averaging $31.65; No. 5 stope, 125 tons, $14.40; 2,500 level No. 1 stope, 200 tons, $12.56; 2,700 level north drift opened to 200-ft. point.

CROWN POINT-BELCHER (Gold Hill)—Sent 390 tons ore to gloryhole from shaft bins. From Jacket 300 level, 4 cars of ore saved while cleaning out crosscut. In 600 level, No. 3 stope saved 462 cars ore. Joint incline water held 65 ft. below 1,600 level. Saved 4 cars 1,400 east crosscut. Sent 496 tons mine ore and 430 tons of dump rock to mill bins. One bar bullion shipped.

OPHIR & CON. VIRGINIA (Virginia)—Drift on east vein 2,700 level, both faces in heavy quartz formation dipping east, low assay. Sampling orebodies on 2,450, 2,400, 1,600 levels and above under direction of H. L. Slosson, Jr., president. Report states that on 2,450 level 4 ft. ore averaged $35 per ton; extent of orebody not yet determined. Intention to take ore out through Union shaft, to Mexican mill. On 2,700 level drift being advanced into unexplored ground, several hundred feet distant from any other lateral working.

NEW MEXICO

Grant County

OLDEM (Steins)—Zinc and lead claims sold by William Charles to T. B. Bennet, of Tucson, Ariz. Consideration, $10,000.

CARLISLE (Steeplerock)—Carlisle shaft now unwatered and shipments of lead ore being made. Erecting experimental plant to test complex ores.

Sierra County

SNAKE (Hillsboro)—Diesel engine now in operation. Station at 300-ft. level Opportunity mine being retimbered.

Socorro County

HEMBRILLO (Tularosa)—Company has purchased engine, compressor, drills and fittings. Tunnel being driven by H. R. Douglas.

OHIO

YOUNGSTOWN SHEET AND TUBE (Youngstown)—Has bought entire capital stock of Andrews & Hitchcock Iron Co. for $2,500,000. The latter has two 400-ton blast furnaces at Hubbard. Included is interest in Mahoning mine, Mesabi Range, coal lands in Pennsylvania and ore freighters on Lakes.

SOUTH DAKOTA

Lawrence County

ORO HONDO (Deadwood)—Shaft has reached depth of 2,000 ft., making it deepest working in Black Hills. After continuing exploratory work at this depth, sinking will be resumed.

HOMESTAKE (Lead)—Concentrator of 20 tons' daily capacity being installed to handle low-grade tungsten ore taken from North Lead properties. Mining high-grade material and regular shipment continues.

Pennington County

HOMELODE (Silver City)—Machinery installed on original Homelode recently purchased, and shaft will be sunk several hundred feet. Main shaft on property being continued and soon as orebodies are thoroughly developed, plant to treat product from both properties will be erected.

UTAH

Juab County

SIOUX CONSOLIDATED (Eureka)—Work on company account will be resumed. Shaft will be sunk from present 600-ft. depth to prospect for continuation of copper orebody recently opened on the 1,100 level of Iron Blossom. Lessees shipping from 300, 400 and 450 levels.

COLORADO CONSOLIDATED (Silver City)—New company will control 26 claims of Colorado Mining and Beck Tunnel. Work will be done through Beck Tunnel shaft—down 1,100 ft.—and both properties operated more cheaply than formerly. Capitalization 2,500,000 shares, par value 10c.; stockholders in old companies to receive share for share; 500,000 shares will be left in treasury. J. William Knight is manager.

Summit County

DALY-JUDGE (Park City)—Name of company changed from Daly-Judge Mining to Daly-Judge Mining and Smelting; capitalization increased from 300,000 to 500,000 shares, of which 20,000 remain in treasury. Changes made to finance new zinc plant, on which work will begin soon. New orebody opened in January raised on for 180 ft., and raising will continue. No development thus far done along strike.

CANADA

Ontario

ORE SHIPMENTS OVER THE T. & N. O. RY. for the month of March, 1916, from Cobalt proper mines were as follows: Alladin, 23 tons; Beaver, 73; Buffalo, 62; Cobalt Comet—by Dom. Red. Co., 54; Coniagas, 30; Crown Reserve, 40, by Dom. Red. Co., 80, total, 120; Kerr Lake, 30, by Dom. Red. Co., 82, total 112; La Rose, 153; McKinley-Darragh, 154; Mining Corp'n. of Canada, Cobalt Lake, 98, Townsite-City, 127, total, 225; Nipissing, 130; O'Brien, 36; Penn Canadian, 49; Peterson Lake (Seneca Superior), 110; Right of Way, 48; Temiskaming, 30; total for Cobalt, 1,413 tons. From New Liskeard, Casey Cobalt, 32 tons; from Elk Lake, Miller Lake O'Brien, 20 tons; total silver-ore shipments, 1,465 tons. Additional shipments from other points were as follows: From Schumacher, Porcupine Vipond, 1.23 tons gold ore; from Timmins, Hollinger, 41.5 tons gold ore; from Porquis Jct., Alexo mine, 1,041.45 tons nickel ore.

LAKE SHORE (Kirkland Lake)—Struck new oreshoot on 300-ft. level; crosscut shows 5 ft. $20 ore.

TRETHEWEY (Cobalt)—Will be reopened after year's shutdown. Over 500,000 oz. silver in sight can be profitably mined at present high prices.

CONIAGAS (Cobalt)—Made first shipment precipitates from cyanide plant. Mill treating 180 tons a day; sufficient broken ore in mine to keep mill running two years.

LA ROSE (Cobalt)—Has obtained encouraging results in diamond drilling Maidens MacDonald property at Porcupine. Vertical shaft being sunk to cut vein at depth of 125 ft.

TECK HUGHES (Kirkland Lake)—Being unwatered so that No. 1 and No. 3 shafts can be connected by crosscut from 200-ft. level. Mill practically completed but will be held up till power arrives some time during summer.

MILLER INDEPENDENCE (Boston Creek)—Installing Nissen stamp and small oil-flotation plant. Newspaper reports about richness of veins in this section mostly "pipe dreams," although district well worth attention of prospectors.

MEXICO

Chihuahua

AMERICAN SMELTING AND REFINING (Parral)—Santa Barbara lead-zinc mines, 30 mi. south of Parral, reported raided and looted by Mexican bandits.

ALVARADO (Parral)—Reported from Mexican sources that mill and property badly damaged, stores looted and destroyed by rioting natives and alleged Carranza troops.

Sonora

GREENE-CANANEA (Cananea)—March production was 5,388,000 lb. copper; 200,709 oz. silver, and 1,146 oz. gold.

INDIA

MYSORE GOLD (Mysore)—Fire starting at 1,290 level of Gilbert shaft on Mar. 22 destroyed timbering to surface; three men missing. Ribbedale and McTaggart shafts resumed work on Mar. 28; smoke practically stopped Gilbert section.

The Market Report

Metal Markets

NEW YORK—Apr. 19

Following the great outbursts of activity all of the metals became more quiet during the last week. This was reflected in easing of prices in the cases of lead and spelter, but copper rose.

Copper, Tin, Lead and Zinc

Copper—Another large block of copper was sold to a foreign government about the end of the last calendar week, at about 28¼c. per lb. Apart from that transaction there were no other large orders placed during the week, but there was steady buying in relatively small quantities by domestic manufacturers. The situation has developed that the principal producers are sold out up to August. On the other hand, there is for the moment scarcely any demand for April copper and but little more for May-June. The sellers who have any copper left this side of August are asking stiff premiums for it, such as 30c. for prompt, and 29½c. for May, and when anybody needs copper for those deliveries he pays what is asked. However, such business is but trifling, the major market for copper now being July and beyond, and during the latter part of the week the price for such deliveries rose on relatively small business to 28@28½c. On the other hand, copper for delivery toward the end of 1916 was offered on lower terms.

Visible Stocks of Copper in Europe on Apr. 15 are reported as follows: Great Britain, 3,407; France, 3,400; afloat from Chile, 2,800; afloat from Australia, 5,300; total, 14,907 gross tons, or 33,391,680 lb. This is an increase of 2,829 tons over Mar. 31 and of 419 tons over the Mar. 15 report.

Copper Sheets, base price is quoted at 35½c. per lb. for hot rolled and 36½c. for cold rolled. Copper wire is quoted at 31½@32c. per lb. for large lots at mill.

Tin—The demand for spot was light, but there was a good business in futures. The market did not exhibit any special feature of interest.

Lead—This market exhibited a softening tendency right from the beginning of the week. The demand, as reported by nearly all of the large producers, was light in comparison with what it was in recent weeks, and sellers were disposed to take what they could get. Some large lots were sold in the St. Louis market at sharp concessions. The St. Louis market therefore began during the week to return to its normal relation with New York as to price.

Beginning Apr. 1 all mining companies in British Columbia will receive $7.25 per 100 lb. for all lead that goes to the British government for munition purposes until June 30, after which the July, August and September deliveries will be settled for on a basis of $8.30. This announcement was made by the Consolidated Mining and Smelting Co. of Canada, owner of the Trail smeltery, where the product of many British Columbia properties is being treated. Heretofore lead producers have been getting 5c. per lb. for their output.

Spelter—A large business in brass special was again done during the last week, but business in common spelter was relatively light. Such as was transacted was chiefly for export, a few round lots destined for abroad being sold. The preponderance of business was for deliveries in the third and third-fourth quarters of the year. Near-by spelter was neglected. Some small producers who confined their selling chiefly to near-by delivery offered their product on lower terms. It was significant also that some persons who had contracted for April delivery requested postponement thereof.

L. Vogelstein & Co. have commenced the erection of a three-block smeltery at Van Buren, near Ft. Smith, Ark. H. H. Whiteside will be superintendent.

Imports at Baltimore for the week included 2,494 tons blende from Cartagena, Spain.

The U. S. Geological Survey states that every producer of spelter was asked to give the average price at which his output in 1915 was sold, and from those returns, which were received from every producer, the average selling price for 1915 for all grades was determined at 12.4c. per pound.

Zinc Sheets, base price is still $25 per 100 lb., f.o.b. Peru, Ill., less 8% discount. Business has been very active.

SPANISH EXPORTS

Spanish mineral exports year ended Dec. 31 as reported by "Revista Minera" in metric tons:

	Metals		Ores, etc.	
	1914	1915	1914	1915
Iron	39,177	125,839	6,095,121	4,449,273
Copper	16,320	16,312	82,300	30,146
Copper precipitate	10,056	10,443	.....	.....
Lead	152.771	161,322	1,834	907
Zinc	3,274	4,581	65,149	33,629
Quicksilver	1,285	1,121	.....	.....
Manganese	.....	.....	8,968	9,186
Pyrites	.....	.....	2,553,798	2,263,216
Salt	.....	.....	509,278	487,567

Imports of coal in 1915 were 1,726,352 tons, a decrease of 678,633 tons from 1914; imports of coke, 178,692 tons, a decrease of 192,076 tons.

DAILY PRICES OF METALS IN NEW YORK

Apr.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	St. Louis, Cts. per Lb.
13	4.7631	63	27½ @28	53	7.50 @7.80	7.60 @7.80	15.75 @17.75
14	4.7631	63½	27½ @28½	53	7.50 @7.75	7.55 @7.65	15.75 @17.75
15	4.7631	63½	28 @28½	53	7.50 @7.75	7.55 @7.65	15.50 @17.50
17	4.7631	64	28 @28½	52	7.50 @7.70	7.45 @7.55	15.50 @17.50
18	4.7650	63½	28 @28½	51	7.50 @7.70	7.45 @7.55	15.50 @17.50
19	4.7650	64½	28 @28½	50	7.50 @7.65	7.45 @7.55	15.50 @17.50

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are as reported by Handy & Harman and are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Apr.	Silver	Copper				Tin		Lead		Zinc	
		Standard		Electrolytic							
		Spot	3 Mos.	£ per Ton	Cts. per Lb.	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
15	30	124	121	136	28.96	199½	198¼	35½	7.02	100	21.29
14	30⅛	126	121	137	29.17	200	198¼	35¼	7.02	100	21.29
15	30⅛	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17	30 1/16	127	122	137	29.17	201	198½	35⅛	6.99	102	21.72
18	30 1/16	128	123	138	29.38	200	198	35⅛	6.99	103	21.93
19	30⅛	130½	125	139	29.60	198	196½	35⅛	6.99	103	21.93

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £ 15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅜c.

Other Metals

NEW YORK—Apr. 19

Aluminum—Business has been rather quiet and the sales moderate. The market is rather easy and may be quoted at 58@60c. per lb. for No. 1 ingots, New York. The chief producer here seems to be more inclined to quote on futures.

Antimony—Spot and near-by is quoted at 40@41c. per lb. with the market quiet and soft. Shipments from China within one month quoted 32@33c. per lb., c. i. f., N. Y., duty unpaid.

Quicksilver—The depression in prices has gone a little further this week. Demand in the East has been moderate and quotations in New York are $125@128 per flask of 75 lb. There are reports of one or two sales down to $115, but they cannot be verified. San Francisco reports by telegraph a very quiet market, with quotations $135@140 per flask and few sales.

Nickel—Business is steady and prices unchanged. Ordinary forms are 45@50c. per lb., according to size and terms of order. Electrolytic nickel is 5c. per lb. higher.

Minor Metals—Current quotations for **Bismuth** are $3.15@3.25 per lb. New York. The London price is 11s. per lb.—**Cadmium** is quoted at $1.25@1.50 per lb.—**Cobalt** is $1.25 per lb.—**Magnesium** is quoted at $5.50 per lb. for 99% pure.—**Selenium** is from $3 up to $5 per lb., according to quantities.

IMPORTS AND EXPORTS

Imports and Exports of the Minor Metals in the United States, year ended Dec. 31, as reported by the Department of Commerce, in pounds, except platinum, which is in troy ounces:

	Imports		Exports	
	1914	1915	1914	1915
Nickel	35,006,770	56,352,582	27,595,152	26,418,550
Antimony	15,056,463	20,858,042	160,979	3,146,135
Aluminum	16,241,340	8,534,834	129,750	40,102
Quicksilver	.....	.....	108,426	252,852
Platinum, oz.	72,267	61,437	143	9

Exports include reëxports of foreign material. In addition to the quantities given above, manufactures of aluminum were exported valued at $1,546,510 in 1914 and $3,682,117 in 1915. Nickel and antimony include metallic contents of ore, matte and regulus.

Exports of brass in January are reported by the Department of Commerce at 5,216,028 lb. in 1915, and 12,237,532 lb. in 1916; an increase of 7,021,504 lb. this year. In addition there were articles of brass, weight not given, exported, valued at $771,934 in 1915, and $3,845,254 this year.

Gold, Silver and Platinum

NEW YORK—Apr. 19

Gold in the United States Apr. 1, as estimated by the Treasury Department: Held in Treasury against gold certificates outstanding, $1,481,958,309; in Treasury current balances, $215,303,167; in banks and circulation, $619,686,944; total, $2,316,948,420. This is an increase of $440,621,881 over Apr. 1 last year.

The Australian Government has removed the prohibition on exports of gold from the Commonwealth. All exports will be made under supervision of the treasury.

Gold receipts of the Australian Mint in January were: Sydney, 33,081 oz.; Melbourne, 37,186; Perth, 115,463; total, 185,730 oz. All of this was Australian gold with the exception of 7,382 oz. from New Zealand and 735 oz. from New Guinea.

Platinum—The market continues dull, with sales on a limited scale only. There is little change in prices. Sales of refined platinum are reported at $80@86 per oz. Hard metal is about $5 per oz. higher.

Platinum valued at $504,302 was invoiced at the American Consulate at Cartagena, Colombia, for the United States during 1915, compared with $357,519 worth for 1914.

Silver—The market has had a rapid advance in London. This seems to be owing chiefly to the fact that mintage orders are absorbing supplies at rising prices. Speculation as to the future of silver depends on so many unknown quantities that it is not safe to forecast its course at present, though the tendency seems to be upward.

Coined Silver in the United States Apr. 1 is estimated by the Treasury Department as follows: Standard dollars, $568,270,900; subsidiary coins, $187,466,970; total, $755,737,870. Of the standard dollars $486,906,393 are held in Treasury against silver certificates outstanding.

Zinc and Lead Ore Markets

PLATTEVILLE, WIS.—Apr. 15

The base price paid this week for 60% zinc ore was $106@112 per ton. The base price paid this week for 80% lead ore was $95 per ton.

SHIPMENTS, WEEK ENDED APR. 15

	Zinc Ore, Lb.	Lead Ore, Lb	Sulphur Ore, Lb
Week	4,470,000	558,560	613,500
Year	62,716,000	1,780,010	15,756,606

Shipped during week to separating plants, 7,272,000 lb. zinc ore.

JOPLIN, MO.—Apr. 15

Blende, high price, $127.35; per ton 60% zinc, premium ore, $125; medium grades, $119@110; lower grades down to $100; calamine, per ton 40% zinc, $90@75; average selling price, all grades of zinc, $115.28 per ton. Lead, high price, $103.65; per ton 80% metal contents, $101@100; average selling price, all grades of lead, $99.94 per ton.

SHIPMENTS WEEK ENDED APR. 15.

	Blende	Calamine	Lead	Values
Totals this week..	19,258,020	1,997,130	2,420,110	$1,345,840
Totals this year..	210,202,570	19,365,170	35,038,720	$13,990,060

Blende value the week, $1,143,770; 15 weeks, $11,713,470.

Calamine value, the week, $81,140; 15 weeks, $723,660.

Lead value, the week, $120,930; 15 weks, $1,552,930.

The total zinc tonnage of 10,628, even though the greatest single week's shipment, fails to represent fully the heavy buying of the past two weeks. The demand weakened toward the close of this week and the market was comparatively easier than the opening. While there are some 7,000 tons of ore in the bins, there is very little unsold, and the production is around 9,000 tons per week. A 5-in. rain last night may affect next week's output, though but slightly. Settlement between the machine shops and the striking machinists has not been made. As most shops have nonunion employees no serious effect has been reflected on the mines.

OTHER ORES

Manganese Ore—A recent large sale of Brazilian manganese ore for shipment to the United States is reported. The price was 40c. per unit f.o.b. ship. With current freight rates this would bring the price at Philadelphia or Baltimore up to 60@65c. per unit. It is said that this purchase about cleans up all the Brazilian ore available for early shipment.

Antimony Ore—Steamship companies will accept shipments only subject to space which may be available which makes ore practically unobtainable, therefore the quotation of $2.70 per unit is purely nominal. Stocks in New York have changed hands this week at $3 per unit.

Tungsten Ore—Transactions accepted this week at $75 per unit for 60% to 65% WO_3 ore. Sharp recession in price caused by newspaper interviews with a member of a banking firm acting as purchasing agent for the Allies, who has just returned from Europe, to the effect that no further large war orders would be placed in this country. This was coupled with recent large receipts by steamer, supplying immediate demands.

Spanish Pyrites is quoted at 16c. per unit of sulphur for furnace size and 15½c. per unit for lump, both ex-ship, Atlantic port. These prices are based on an ocean rate of 10s. per ton, buyer to pay all excess of freight charge over 10s. Recent rates paid are 25s. per ton.

NEW CALEDONIA ORES

Exports from New Caledonia in January are reported by the "Bulletin du Commerce" of Noumea at 6,094 metric tons of chrome ore. No nickel ore was reported.

Iron Trade Review

NEW YORK—Apr. 19

Perhaps the most interesting point in the news this week is the announcement that rail prices will be advanced $5 per ton on May 1, making the quotations on bessemer steel $33 and openhearth $35. The announcement was made by the Steel Corporation and generally followed by the independents. Rail prices have not been changed for 15 years, through all the variations of the markets. The immediate effect will be small, however, as the Steel Corporation announced some weeks ago that orders at $28 and $30 would be taken only until May 1, and many railroad companies have already placed their orders for 1917 delivery at the old prices. The new quotations will remove some of the spread between rails and billets, though a considerable difference will still remain, billets being the higher.

Exports from Baltimore for the week included 9,547,093 lb. of steel bars and billets, 5,709,174 lb. steel rails and splices and 1,615 tons car frames to France; 3,500 tons steel rails to Italy; 2,761,334 lb. steel skelp to Great Britain.

The United States Steel Corporation has announced that it will make an advance of 10% in wages generally on May 1. The Youngstown Sheet and Tube Co., the Brier Hill Steel Co. and the Republic Iron and Steel Co. have announced similar advances, and other independents will probably do the same.

The British embargo on exports has been extended to include pig iron, steel billets and some other forms of steel.

PITTSBURGH—Apr. 18

The labor shortage in the steel industry, which was feared as long as a year ago, has weekly grown more acute. There was a general wage advance Feb. 1, averaging more than 10%, but many men have lately been employed at premium wages, the mills virtually bidding against each other. The shortage appears to have been most acute in the Youngstown district, and yesterday the three leading independent steel intrests in that district, Republic, Youngstown Sheet and Tube and Brier Hill, announced a second general advance in common labor of 10%. This was promptly followed today by the Steel Corporation announcing, not an advance in the Youngstown district, but an advance in all its mills of 10%, effective May 1. Other steel producers will necessarily follow and the unprecedented thing in the steel industry will have occurred of two general advances with an interval of only three months. Whether these advances will furnish enough men to enable the mills to run at capacity is a question, although they are already practically assured orders enough to run them full into next year. The very serious labor situation was emphasized in last report.

The Pennsylvania R.R. system is distributing orders for 205,000 tons of rails for 1917 delivery, making fully 500,000 tons ordered for that delivery thus far this month, in addition to about 900,000 tons ordered last month. An advance of $5 a ton, the first since February, 1901, occurs May 1, to $33 for Bessemer and $35 for openhearth rails.

The total bookings in steel products, apart from rails, have continued to decrease, as neither buyers nor sellers are interested in the far-off deliveries and there is little to be had for early deliveries. The pressure for material already bought is as great as ever, if not greater, and specifications on present contracts are very heavy. Some of these contracts are at relatively low prices, about 1.40c. for bars, plates and shapes, but there is much higher priced business also being filled.

Pig Iron—The Youngstown Sheet and Tube Co. has purchased the stock of the Andrews & Hitchcock Iron Co., operating two merchant blast furnaces and with important Lake Superior iron-ore holdings, at the reported price of $2,500,000. Otherwise the steel company would have continued to buy merchant iron, since it recently decided not to build a fifth furnace, on account of high construction costs. The purchase will narrow the supply of merchant iron and tends to stiffen the situation. The pig-iron market at the moment, however, continues dull, with prices firm but not advancing. We quote: Bessemer, $21@21.50; basic, malleable and foundry, $18.50@19; gray forge, $18@18.50, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Steel—There are occasional offerings of steel, but nothing general. The mills will scarcely ever quote on ordinary soft steel, but are offering considerable tonnages made from rejected war steel. This material finds a ready sale, consumers adapting it to their use through lacking anything better. We quote the market nominally at $45 for bessemer billets and sheet bars and $45@50 for openhearth, with forging billets $65 and upwards, ordinary rods at $65 and high-carbon rods $75@85 per ton.

FERROALLOYS

Ferrosilicon, 50%, is still quoted nominally at $83@85 per ton, Pittsburgh; but for early deliveries $90@95 has been paid. Bessemer ferrosilicon is quoted at $30 per ton at furnace for 9% up to $41 per ton for 16% alloy.

Spiegeleisen is in demand and 20% has sold up to $80 per ton for spot shipment. Futures are still quoted at $70@75 per ton at furnace.

Ferromanganese—Occasional sales of prompt lots occur at $400@450 but there are no regular offerings. Contract remains at $175, with deliveries offered for the first half of 1917.

FOREIGN IRON

Steel Production of Austria-Hungary year ended Dec. 31, 1915, in metric tons:

	Austria	Hungary	Bosnia	Total
Converter steel	241,537	153	.....	241,690
Open-hearth	1,672,766	679,024	19,157	2,370,947
Wrought (puddled)	16,229	7,314	.....	23,543
Crucible	25,530	621	.....	26,151
Electric	22,740	1,155	.....	23,895
Total	1,978,802	688,267	19,157	2,686,226

The total shows increases of 495,467 tons over 1914, and of 3,607 tons over 1913. Of the converter steel reported in 1915 only 645 tons were acid the rest being basic. All the openhearth steel was basic. Of the puddled metal 12,029 tons were iron and 11,514 tons steel.

German Steel Production in January is reported by the German Iron and Steel Union as below, in metric tons:

	Basic	Acid	Total
Converter	583,744	14,393	598,137
Open hearth	506,217	26,852	533,069
Direct castings	46,056	24,946	71,002
Crucible	.....	8,230	8,230
Electric	.....	14,294	14,294
Total	1,136,017	88,715	1,224,732

The total make was 59,267 tons more than in December; 260,942 tons more than in January, 1915; but 375,025 tons less than in January, 1913. In January, 1915, there were 261 works reported in operation.

Pig-Iron Production in Great Britain in 1915 is reported at 8,793,659 gross tons, being 212,239 tons less than in 1914, and 1,694,258 tons less than in 1913. The home consumption in 1915 is estimated at 8,500,000 tons.

IRON ORE

Shipments of Lake ore from Lake Erie docks to furnaces in March were 1,347,130 tons; for the three months ended Mar. 31 they were 3,094,822 gross tons; an increase of 1,895,222 tons over 1915. Stocks remaining on docks Apr. 1 were 4,894,495 tons being 1,967,345 tons less than on Apr. 1, 1915. These are the smallest dock stocks reported for nine years.

COKE

Coke production for the week in the Connellsville region is reported by the "Courier" at 465,664 net tons; shipments, 465,475 tons. Shipments of Greensburg and Upper Connellsville districts, 43,494 tons.

For the quarter ended Apr. 1 the total Connellsville production was 5,687,138 tons; shipments, 5,613,831 tons. These are the highest figures ever reported.

Connellsville—The spot furnace coke market continues soft, at $2.25@2.50, and this low range has discouraged inquiry for second half, when sellers have been asking $2.50@3. The market in future will probably hinge on labor supply as the region has shown ability to furnish all the coke needed, with pig-iron production at probably the maximum rate attainable. Completion of byproduct ovens is much slower than expected, the plants under construction being about three months late on an average. Fully 2,000 byproduct ovens are under construction or definitely planned by the Steel Corporation and independents, but only about a fourth of these can be completed within the next three or four months. Foundry coke is firm at $3.75 for spot and $3.50 for contract.

Anthracite Shipments in March were 6,127,351 gross tons, an increase of 1,052,058 tons over March, 1915. For the three months ended Mar. 31 the total shipments were 14,258,807 tons in 1915, and 17,708,007 in 1916; an increase of 3,449,200 tons, or 24.2%, this year.

Chemicals

NEW YORK—Apr. 19

The general markets are in good shape with a fair business reported in heavy chemicals and much activity in acids.

Arsenic shows only light demand from the paris-green manufacturers, but glass makers are buying rather freely. Prices are steady at $6.50 per 100 lb. for both spot and futures.

Copper Sulphate—There is no change in the market, demand being steady both for home consumption and export. Quotations are $20@21 per 100 lb. for carload lots and over.

Nitrate of Soda—Business is good, but stocks are reported large. Imports have been heavy, the increase in arrivals having exceeded the quantities taken by powder makers. The current quotations are $3.35@3.40 per 100 lb. for spot and early deliveries.

Sulphur—The market is firm at the recent advance, which was due chiefly to high freight rates. Quotations are $29.50 per gross ton for New York delivery.

PETROLEUM

Exports of petroleum from the United States in February were 179,036,487 gal., an increase of 27,293,545 gal. over last year. For the two months ended Feb. 29 the exports were 298,036,724 gal. in 1915, and 351,235,585 gal. in 1916; an increase of 53,198,861 gal. or 17.9%, this year.

Exports of petroleum from Mexico in February were: Tampico, 1,278,803; Tuxpam, 801,138; total, 2,079,941 bbl.

Assessments

Company	Delinq.	Sale	Amt.
Adventure, Mich.	July 20	.....	$0.50
Andes, Nev.	May 9	May 31	0.02
Benton, Ida.	Apr. 15	May 15	0.005
Caledonia Silver, Nev.	Apr. 7	Apr. 28	0.05
Demijohn, Nev.	Apr. 14	May 5	0.005
Dennemora, Ida.	Apr. 5	May 15	0.002
Diam'dfield Black Butte, Nev.	Apr. 12	May 18	0.01
East Hercules, Ida.	May 1	June 1	0.0015
Echo, Ida.	Apr. 14	May 15	0.002
Elise, Utah.	Apr. 12	May 18	0.0025
Eureka Dev. Utah.	Apr. 10	May 1	0.02
Federal Ely, Nev.	Apr. 1	May 1	0.005
Federal Ely. Nev.	May 1	June 4	0.005
Friend, Ida.	Apr. 28	May 20	0.002
Great Bend, Nev.	Apr. 5	May 8	0.01
Horseshoe, Ida.	Apr. 22	May 13	0.03
Howell, Utah.	Apr. 15	May 3	0.01
Idaho-Nevada, Ida.	Apr. 7	May 1	0.002
Index, Ida.	Apr. 6	May 6	0.0025
Laclede, Ida.	Apr. 25	May 15	0.003
National Copper, Ida.	Mar. 25	Apr. 22	0.01
Neva, Utah.	Apr. 13	May 1	0.002
Nevada-Douglas.	Apr. 17	May 16	0.10
North Bunker Hill, Ida.	Apr. 18	May 20	0.002
Old Veteran, Ida.	May 6	June 3	0.02
Overman, Nev.	May 3	May 23	0.05
Park Gold, Utah.	Apr. 1	Apr. 20	0.001
Republic, Utah.	Apr. 22	May 13	0.005
Rhode Island, Ida.	Mar. 30	May 15	0.002
Rio Grand Grubstake, Nev.	Mar. 27	Apr. 22	0.006
Sierra Nevada, Nev.	May 5	May 25	0.05
Summit Ex., Utah.	Mar. 15	May 1	0.01
Sunset, Nev.	Mar. 27	Apr. 29	0.01
Tarbox, Ida.	May 6	June 6	0.05
Tiberius, Ida.	Apr. 15	May 15	0.001
Tonopah Bonanza, Nev.	Apr. 3	May 8	0.01
Tono. Gypsy Qn., Nev.	Mar. 20	Apr. 24	0.01
Umatilla, Nev.	Apr. 17	May 22	0.005
Utah-Arizona, Ariz.	Apr. 14	May 16	0.0025
Utah Con., Utah.	Apr. 22	May 13	0.005
Wasatch, Utah.	Apr. 3	May 8	0.01

Stock Quotations

SAN FRANCISCO Apr. 17	Bid.
Alta	.04
Andes	.06
Best & Belcher	.04
Bullion	.01
Caledonia	.40
Challenge Con.	.05
Confidence	.15
Cons. Imperial	.01
Con. Virginia	.11
Gould & Curry	.02
Hale & Norcross	.04
Jacket-Cr. Pt.	.14
Mexican	.09
Occidental	.70
Ophir	.20
Overman	.06
Savage	.04
Seg Belcher	.03
Sierra Nevada	.19
Union Con.	.44
Utah Con.	.01
Belmont	4.70
Jim Butler	.97
MacNamara	.15
Midway	.34
Mont.-Tonopah	.37
North Star	.20
Rescue Eula	.51
W. st End Con.	.78
Atlanta	.13
Blue Bell	.02
Booth	.27
C.O.D. Con	.04
Comb. Frac	.09
D'field Daisy	.03
Jumbo Extension	.75
Pitts.-Silver Peak	.07
Round Mountain	.70
Sandstorm Kendall	.04
Silver Pick	.09
Central Eureka	.11
Argo	.50
Big Jim	2.00
Lazy Boy	.31
Oatman Cres.	.43
Oatman No. Star	.23
Tom Reed	1.70
United Eastern	3.93
United Western	.31

LONDON Apr. 4	
Alaska Tre'dwell	£6 12s 0d
Burma Corp.	1 14 6
Cam & Motor	0 11 0
Camp Bird	0 7 3
El Oro	0 8 3
Esperanza	0 9 6
Mexico Mines	3 15 0
Nechi, pfd.	0 14 0
Oroville	0 14 3
Santa Gert'dis.	0 10 6
Tomboy	1 1 6
Tough Oakes	0 11 3

SALT LAKE Apr. 18	Bid.
Beck Tunnel	.21
Black Jack	.12
Colorado Mining	.21
Crown Point	.07½
Daly-Judge	7.65
Emma Cop.	.54
Gold Chain	.28
Grand Central	.76
Iron Blossom	1.67½
Lower Mammoth	.06½
May Day	.17½
Opohongo	.02½
Prince Con.	1.21½
Seven Troughs	.02½
Silver King Coal'n	2.90
Silver King Con.	2.92½
Sioux Con.	.18
Uncle Sam	.08½
Yankee	.30

COLO. SPRINGS Apr. 17	
Acacia	.04
Cripple Cr'k Con.	‡.005
Doctor Jack Pot	.10½
Elkton Con.	.26
El Paso	.88
Findlay	.04½
Gold Dollar	‡.01
Gold Sovereign	.04
Golden Cycle	2.25½
Isabella	.20
Jack Pot	.06½
Jerry Johnson	.05
Mary McKinney	.35
Portland	.70
Vindicator	2.30

TORONTO Apr. 18	
Bailey	.07
Chambers Ferland	.27
Conlagas	4.25
La Rose	.56½
Peterson Lake	.28
Right of Way	.03½
Seneca Superior	.48
T. & Hudson Bay	25.00
Temiskaming	.63
Trethewey	.18
Wettlaufer-Lor.	.06
Dome Exten.	.38
Dome Lake	.26
Foley O'Brien	.50
Hollinger	28.00
Imperial	‡.04
Jupiter	.20
McIntyre	.93
Porcu. Crown	.75
Preston E. D.	.05
Vipond	.55
West Dome	.23

N. Y. EXCH. Apr. 18	Clg.
Alaska Gold M.	20
Alaska Juneau	9½
Am.Sm.&Ref.,com	98
Am. Sm. & Ref., pf.	112½
Am. Sm. Sec., pf. A	93½
Am. Sm. Sec., pf. B	85
Am. Zinc	93½
Anaconda	85½
Batopilas Min.	2½
Bethlehem Steel	440
Bethlehem Steel, pf.	130
Butte & Superior	93
Chile Cop.	22½
Chino	53½
Colo. Fuel & Iron	42
Crucible Steel	85½
Dome Mines	25
Federal M. & S.	15
Federal M. & S., pf.	38½
Great Nor., ore., ctf.	41½
Greene Cananea	47½
Guggen. Exp.	‡21½
Homestake	129
Inspiration Con.	45½
International Nickel	48½
Kennecott	55½
Lackawanna Steel	73
Miami Copper	38
Nat'l Lead, com.	65½
National Lead, pf.	114½
Nev. Consol.	18
Ontario Min.	8½
Quicksilver	2½
Quicksilver, pf.	4
Ray Con.	23½
Republic I&S, com.	49½
Republic I&S, pf.	108
Sloss-Sheffield	52½
Sloss-Sheffield, pf.	91½
Tennessee Copper	49½
Utah Copper	81
U. S. Steel, com.	83
U. S. Steel, pf.	117½
Va. Iron C. & C.	48

N. Y. CURB Apr. 18	
Alta Con.	.30½
Beaver Con.	.39
Buffalo Mines	1½
Butte & N. Y.	2½
Butte C. & Z.	7½
Can. Cop. Corpn.	1 11/16
Cashboy	.08
Cerro de Pasco	38
Con. Ariz. Sm.	1½
Con. Copperm'nes	2 1/16
Con. Nev.-Utah	.50
Dia. Black B.	.04
First Nat. Cop.	6
Florence	.43
Goldfield Con.	.88
Goldfield Merger	.13
Granite	.75
Hecla Min.	4 13/16
Howe Sound	5½
Kerr Lake	4½
Magma	17
Majestic	.75
McKinley-Dar-Sa.	.50
Mines of Am.	3
Mother Lode	.33½
Nevada Hills	.18
New Utah Bingham	3
Nipissing Mines	7½
Oro	.04½
Ray Hercules	4½
Rochester Mines	.61
St. Joseph Lead	16½
Stand'd Oil of N.J.	500
Standard S. L.	1½
Stewart	3/16
Success	.68
Tonopah	6½
Tonopah Ex.	6½
Tonopah Merger	‡.55
Tribullion	11/16
White Knob, pf.	1½
Yukon Gold	2

BOSTON EXCH Apr. 18	Bid
Adventure	4½
Ahmeek	400
Algomah	1½
Allouez	69½
Ariz. Com., ctfs.	8½
Bonanza	.36
Butte-Balaklava	3½
Calumet & Ariz.	73½
Calumet & Hecla	545
Centennial	17½
Copper Range	63½
Daly West	3
East Butte	12½
Franklin	9½
Granby	85½
Hancock	14½
Hedley	20
Helvetia	.35
Indiana	4
Island Cr'k, com.	50½
Island Cr'k, pfd.	‡90½
Isle Royale	27
Keweenaw	6½
Lake	16½
La Salle	4½
Mason Valley	3
Mass.	13½
Mayflower	3½
Michigan	3½
Mohawk	98½
New Arcadian	7½
New Idria	14
North Butte	27½
North Lake	1½
Ojibway	2
Old Colony	3
Old Dominion	69½
Osceola	92
Quincy	93½
St. Mary's M. L.	70½
Santa Fe	2½
Shannon	9
Shattuck-Ariz.	32½
So. Lake	8
So. Utah	.35
Superior	18½
Superior & Bost.	3 15/16
Tamarack	54½
Trinity	8
Tuolumne	.30
U. S. Smelting	73½
U. S. Smelt'g, pf.	52
Utah Apex	4½
Utah Con.	13½
Utah Metal	10
Victoria	3½
Winona	4
Wolverine	56½
Wyandot	1½

BOSTON CURB Apr. 18	
Bingham Mines	12½
Boston Ely	.56
Boston & Mont.	.70
Butte & Lon'n Dev.	.86
Calaveras	4½
Calumet-Corbin	.05
Chief Con.	2
Cortez	.60
Crown Reserve	.48
Davis-Daly	1½
Eagle & Blue Bell	2½
Houghton Copper	2½
Iron Cap Cop., pf.	6½
Mexican Metals	.40
Mojave Tungsten	5½
Nat. Zinc & Lead	3
Nevada-Douglas	.95
New Baltic	2½
New Cornelia	15½
Ohio Copper	.18
Oneco	1½
Raven Copper	.18
Rex Cons.	.17
Rilla	1 1/16
United Verde Ext.	25½

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1914	1915	1916	1914	1915	1916
January	56.572	48.855	56.775	26.553	22.731	26.960
February	57.506	48.477	56.755	26.573	22.753	26.975
March	58.067	50.241	57.935	26.788	23.708	27.597
April	58.519	50.250	.....	26.958	23.709	.....
May	58.175	49.915	.....	26.704	23.570	.....
June	56.471	49.034	.....	25.948	23.267	.....
July	54.678	47.519	.....	25.219	22.597	.....
August	54.344	47.163	.....	25.979	22.780	.....
September	53.290	48.680	.....	24.260	23.591	.....
October	50.654	49.385	.....	23.199	23.925	.....
November	49.082	51.714	.....	22.703	25.094	.....
December	49.375	54.971	.....	22.900	26.373	.....
Year	54.811	49.694	.....	25.314	23.675	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York Electrolytic		London Standard		London Electrolytic	
	1915	1916	1915	1916	1915	1916
Jan.	13.641	24.008	60.756	88.083	65.719	116.17
Feb.	14.394	26.440	63.494	102.667	*	133.167
Mar.	14.787	26.310	66.152	107.714	*	136.000
April	16.811	.....	75.096	.....	*	.....
May	18.506	.....	77.600	.....	*	.....
June	19.477	.....	82.574	.....	95.333	.....
July	18.796	.....	76.011	.....	91.409	.....
Aug.	16.941	.....	68.673	.....	82.333	.....
Sept.	17.502	.....	68.915	.....	85.250	.....
Oct.	17.686	.....	72.601	.....	88.000	.....
Nov.	18.627	.....	77.744	.....	93.273	.....
Dec.	20.133	.....	80.773	.....	100.43	.....
Year	17.275	.....	72.532	.....	.....	.....

TIN

Month	New York		London	
	1915	1916	1915	1916
January	34.260	41.825	156.550	175.548
February	37.415	42.717	176.925	181.107
March	48.426	50.741	180.141	193.609
April	47.884	.....	166.225	.....
May	38.790	.....	162.675	.....
June	40.288	.....	167.636	.....
July	37.423	.....	167.080	.....
August	34.389	.....	151.440	.....
September	33.125	.....	152.625	.....
October	33.080	.....	151.554	.....
November	39.224	.....	167.670	.....
December	38.779	.....	167.000	.....
Av. year	38.590	.....	163.960	.....

LEAD

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
January	3.729	5.921	3.548	5.826	18.606	31.167
February	3.827	6.246	3.718	6.164	19.122	31.988
March	4.053	7.136	3.997	7.375	21.883	34.440
April	4.221	.....	4.142	.....	21.094	.....
May	4.274	.....	4.182	.....	20.347	.....
June	5.932	.....	5.836	.....	25.170	.....
July	5.659	.....	5.531	.....	24.611	.....
August	4.656	.....	4.520	.....	21.946	.....
September	4.610	.....	4.490	.....	23.151	.....
October	4.600	.....	4.499	.....	23.994	.....
November	5.155	.....	5.078	.....	26.278	.....
December	5.355	.....	5.266	.....	28.807	.....
Year	4.673	.....	4.567	.....	22.917	.....

SPELTER

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
Jan.	6.386	16.915	6.211	16.745	30.844	89.810
Feb.	8.436	18.420	8.255	18.260	39.819	97.762
Mar.	8.541	16.846	8.360	16.676	44.141	95.048
April	10.012	.....	9.837	.....	49.888	.....
May	14.781	.....	14.610	.....	68.100	.....
June	21.208	.....	21.038	.....	100.614	.....
July	19.026	.....	18.856	.....	97.250	.....
Aug.	12.781	.....	12.611	.....	67.786	.....
Sept.	13.440	.....	13.270	.....	67.841	.....
Oct.	12.800	.....	12.596	.....	66.536	.....
Nov.	15.962	.....	15.792	.....	88.409	.....
Dec.	15.391	.....	15.221	.....	89.400	.....
Year	13.230	.....	13.054	.....	67.553	.....

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported

PIG IRON IN PITTSBURGH

Month	Bessemer‡		Basic‡		No. 2 Foundry	
	1915	1916	1915	1916	1915	1916
January	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February	14.55	21.16	13.45	18.93	13.90	19.51
March	14.55	21.81	13.45	19.20	13.95	19.45
April	14.55	.....	13.45	.....	13.95	.....
May	14.61	.....	13.60	.....	13.83	.....
June	14.70	.....	13.67	.....	13.77	.....
July	14.94	.....	13.91	.....	13.68	.....
August	16.01	.....	15.31	.....	14.75	.....
September	16.86	.....	15.95	.....	15.70	.....
October	16.95	.....	15.96	.....	15.80	.....
November	17.57	.....	16.47	.....	17.20	.....
December	19.97	.....	18.44	.....	18.95	.....
Year	$15.82	.....	$14.76	.....	$14.95	.....

‡As reported by W. P. Snyder & Co.